Middleborough, Massachusetts

Priorities for Open Space

This project is supported by grants from the Rockefeller Foundation and the National Endowment for the Arts, Washington, D.C., and the Town of Middleborough.

The studies forming part of the basis for this publication were conducted pursuant to a contract eith the Department of Housing and Urban Development. The substance of the study is dedicated to the Public. The Authors and Publisher are solely responsible for the accuracy of the statements or interpretations contained herein.

This project is made possible through the aid of P.A.C.E., Inc., Cambridge, Massachusetts.

Prepared by: The Regional Field Service
Harvard University
Graduate School of Design
Dept. of Landscape Architecture

Authors: Cheryl Barton, Resource Analysis
Alan Fisher, Implementation

Advisors: Douglas S. Way
Kenneth Paolini

November, 1974

MIDDLEBOROUGH, MASSACHUSETTS:

PRIORITIES FOR OPEN SPACE

Cheryl Barton and Alan Fisher

Through his social and political institutions, man attempts to derive value from an environment which is limited in its basic ecological capacity to provide benefits to him. When social values fail to realize this basic "carrying capacity" of the environment, a permanently altered--degraded--condition will result.

From Jon Rodiek
A Resource Atlas of Plymouth County

LIST OF MAPS

Map A	The Base Map	2
1	Surficial Geology	18
2	Soils	22
3	Soil Capability	26
4	Surface Water	30
5	Groundwater Availability	36
6	Wetlands	44
7	Vegetation	48
8	Wildlife	54
9	Unique Resources	58
10	Existing Open Space	62
11	Development Demand	66
12	Natural Resource Composite	70
13	Priority Plan for Open Space	80

LIST OF FIGURES

1	Resident-mapped Points of Interest	4
2	The Planning Process	5
3	Regional Location of Middleborough	6
4	An Early Etching	8
5	Direction of Glacial Ice Flow	12
6	Formation of Glacial Landforms	14
7	Surface Water Quality	27
8	The Hydrologic Cycle	33
9	Groundwater Quality	37
10	Wetland Vegetation Types	39
11	Urban Open Space	60
12	Natural Resource Composite Matrix	68
13	Open Space Development Potential along the Nemasket River	84
14	Land Use/Activity Type Compatibility	85
15	Long Range Acquisition Priorities for the Nemasket River	86

TABLE OF CONTENTS

Preface		i
Foreword		ii
Acknowledgments		iii
Section 1:	Introduction	1
	The Planning Process	1
	The Town	6
	Land Use History	8
Section 2:	The Resource Inventory	10
	Climate and Topography	11
	Surficial Geology	12
	Soils	19
	Soil Capability	24
	Surface Water	27
	Groundwater	32
	Wetlands	38
	Vegetation	46
	Wildlife	50
	Unique Resources	56
	Existing Open Space	59
	Development Demand	64
	Natural Resource Composite	68
Section 3:	Town Goals	72
Section 4:	Priority Plan for Open Space	76
Section 5:	The Nemasket River	82
Section 6:	Implementation Strategies	90
Section 7:	Conclusion	112
Section 8:	Bibliography and Appendix	114

PREFACE

The need for comprehensive open space planning as pressures for suburban development increase is now being recognized by many towns. Conservation and recreation lands serve not only to guarantee future open areas for visual and recreational pleasure, but also, and more importantly, to ensure environmental quality through intelligent use of natural resources.

The Middleborough Conservation Commission provided the impetus for this study. Its members felt the need for basic criteria in order to be more effective in the selection of lands for open space acquisition and preservation. The existing Town Master Plan does not deal adequately with conservation and recreation priorities. It is hoped that the current study will provide supplementary information as well as some objective decision-making criteria.

The primary intent of this report was to inventory the Town's resources, natural, visual and historical, and to demonstrate by a systematic approach how to establish open space priorities. The results are then analyzed and displayed as a future Plan for Open Space, an idealization of the open space potential in Middleborough. Finally, the report suggests strategies to facilitate the implementation of the Open Space Plan.

The goal of the Regional Field Service Team is to provide the Conservation Commission and the Town with an adequate base of information and a planning methodology which they can continue to use in the future. The Plan can be changed and updated as conditions within the Town change. The information contained within the Plan is also intended for use as an educational base: to inform the residents of Middleborough about the value of open space in their town, and to communicate to state and federal agencies the Town's plans for open space.

Although this Open Space Plan and Report has a presumption in favor of natural resource protection, it is not intended as an anti-development plan. Rather, it should serve to define and evaluate the Town's resources and to pinpoint areas of potential conflict between urbanization and environmental quality. We do not assume that everything will be protected. We do assume that sensible choices for land use can be made, and they can be made before the carrying capacity of the land is exceeded.

C.L.B., A.H.F.
Cambridge, Massachusetts
September, 1974

FOREWORD

The Regional Field Service is a program which enables students at Harvard to work with local communities and their Conservation Commissions or Planning Boards in interdisciplinary design and planning studies. It demonstrates to the communities methods of approaching planning problems and of establishing guidelines for planning decisions. Students in the program are given the opportunity to apply their professional training directly to public service work, and thereby benefit from the experience of working in a realistic community setting.

The following report documents a natural resource inventory and analysis, derived from existing data and supplemented by field checks and local interviews, which took place from September 1973 through June 1974. For the most part, the study describes the present resource status, but wherever possible, attempts to describe resource potential for open space.

It is important to realize that the mpas contained within this report are graphic representations of more specific base information which has been given to the Middleborough Conservation Commission. Maps are intended primarily for use as tools for discussion. Questions regarding specific sites should be directed either to the Commission, or to the agency involved in the collection and compilation of the original information. These sources, such as the Soil Conservation Service or the U.S. Geologic Survey, are listed in the descriptive text which accompanies each map.

THE MIDDLEBOROUGH CONSERVATION COMMISSION

Stephen H. Battis

James Bradford

Robert A. Boutin

Constance M. Johnson

Norman L. Massey

Richard Millette

Mary C. Nelson

ACKNOWLEDGMENTS

The authors wish to acknowledge the efforts of all the individuals and organizations that have contributed to this study. We are grateful to the people of Middleborough for their financial support, and to the members of the Conservation Commission for their encouragement and valuable assistance throughout the past year. Special thanks are also due to the Middleborough Historic Commission, the Board of Health, the Parks and Recreation Department, the Planning Board and the Board of Selectmen and the many local residents who took the time to meet with us.

Others we would like to thank are Jim Luty of the Southeastern New England River Basins Commission, David Delaney of the U.S. Geologic Survey, Water Resources Division, Mr. Chandler of the Massachusetts Department of Public Works, Aerial Photogrammetry Division, Mr. Robert LeMire of the Lincoln Conservation Commission, and Dick Weaver, Town Assessor in Middleborough, all of whom provided valuable information for our study. We also appreciate the helpful comments and criticisms of the faculty in Landscape Architecture and the graphic and editorial assistance of Colleen Barton.

1
INTRODUCTION

OBJECTIVES

To define Middleborough's natural, historical and visual resources.

To protect the Town's most significant and fragile water supplies, watershed and wetland areas.

To maintain or enhance the existing rural quality of Middleborough as well as to influence future growth patterns.

To investigate a role for Middleborough as a regional recreation center.

To provide a viable and accessible conservation/recreation 'core' by connecting areas of potential open space value with existing open space and conservation areas.

To investigate realistic alternatives for the implementation of such a 'core' and thereby guide future land acquisition.

To establish a priority system for land acquisition, based upon resource potential and implementation strategies, which can be a continuing tool for open space planning.

THE PROCESS

The process used by the research team consisted of several parts, each dependent upon its predecessors. The procedure involved (1) preparation of a common data base; (2) inventory and mapping of vulnerable natural resources; (3) inventory and mapping of attractive areas for open space acquisition; (4) synthesis of the vulnerability and attractiveness mapping into a composite pattern of potential open space areas; (5) establishment of the Town's goals for conservation and recreation; (6) compilation of a plan of open space priorities for the Town and (7) suggesting implementation strategies.

The Data Base

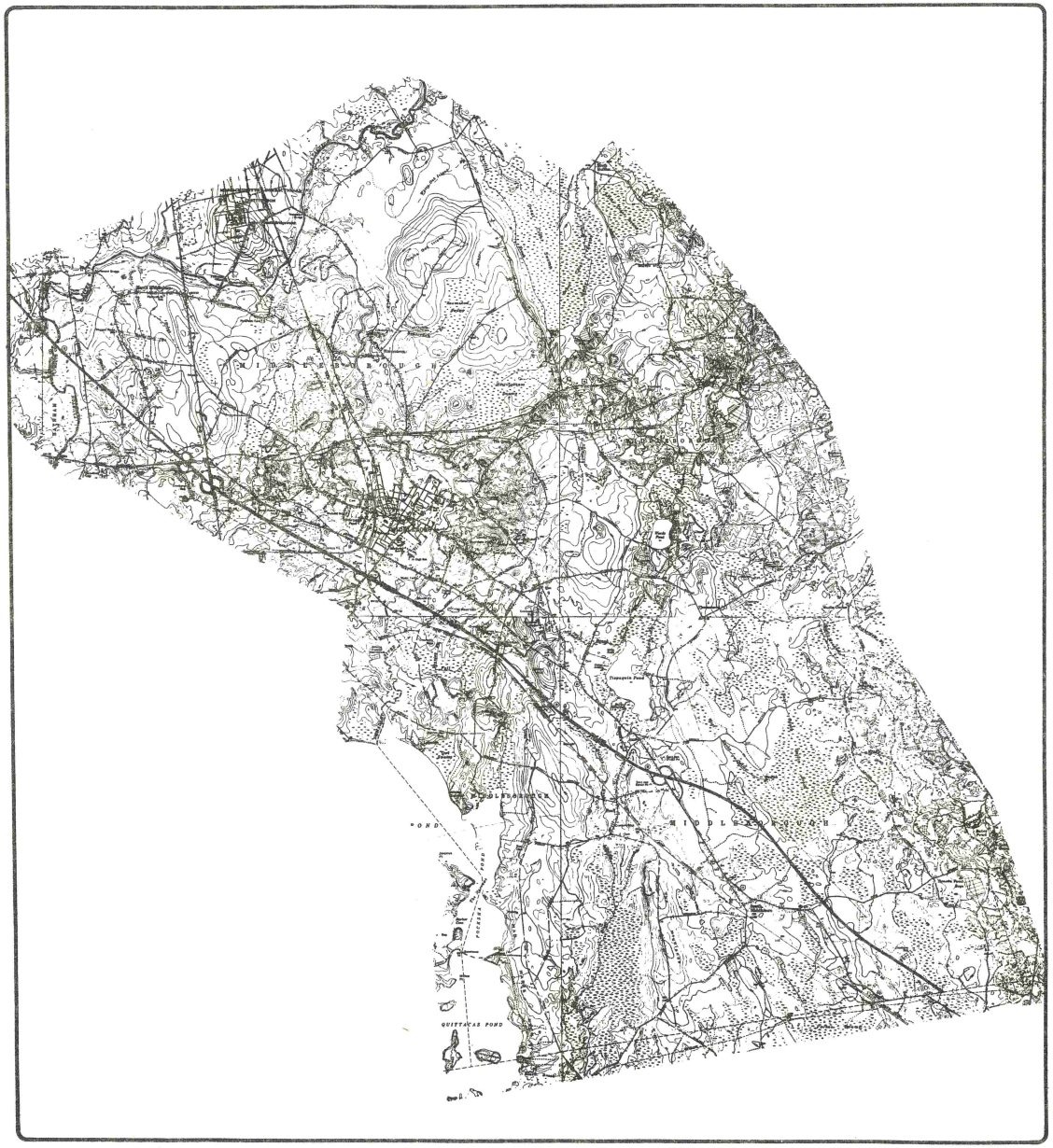
In order to illustrate resource data for the entire Town and maintain a significant level of detail, it was decided to use a scale of 1 inch to 2000 feet, the current scale used by the U.S. Geologic Survey. The same scale was used in the Town Master Plan. The base map was made by assembling four USGS quadrangle maps into one comprehensive map for the Town of Middleborough. Assawompset Pond, Snipatuit Pond, Bridgewater and Plympton quadrangles were used. It should be noted that USGS quadrangle maps have an error factor of up to 5 feet.

Vulnerable Resources Inventory

Some natural resources can be adversely and permanently changed by developemnt of the land. This section attempts to identify areas where surficial geology, soils, hydrology, wetlands, vegetation and wildlife are particularly vulnerable to change. These areas would receive the highest priority for open space designation. Using all available information such as Aerial Photographs (April 1971), Soil Conservation Service Surveys (Plymouth County, 1969), USGS Hydrologic Investigations, relevant publications, professional consultation, knowledgeable local residents and field trips, the natural resource information was documented and mapped at the base scale.

Attractive Resources Inventory

Areas which may not be vulnerable natural resource areas may be attractive as open space for their unique visual or historical character. Also, both their proximity and accessibility to rapidly urbanizing areas creates a demand factor. Although developed land will not figure in the final plan, it is important to know its location and pattern. Existing open space and Town owned lands are significant in this context as basic blocks from which to build a larger open space network. A plan for open space should not only provide specific areas for conservation and



Middleborough Open Space Plan

Map A The Base Map

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

recreation purposes, but should also provide continuity between them. Linear elements in the landscape--streams, trails--become important in this context because they naturally join one piece of land to another. The University of Massachusetts Vegetation Study, Assessor's Maps, subdivision permits, knowledgeable Commission members and Town residents provided most of this information; it was then mapped at the base scale.

Potential Open Space Areas

An overlay of the most vulnerable areas and the most attractive areas determines in a relatively unbiased way those areas best suited to conservation and/or recreation purposes. Areas which incorporate several vulnerability or attractiveness categories have the greatest potential. Potential areas are then described graphically as an overlay on the base map.

Town Goals

It was felt that some determination of a local value system should be made so that decisions about open space in Middleborough were ultimately those of the Townspeople and not of the Regional Field Service team. The Conservation Commission, with suggestions from the RFS team, designed and distributed a questionnaire which was intended to sample the public goals and priorities for open space. The results are tabulated and are described in detail in Section 3.

In addition, various Town commissions and residents were given a blank base map and asked to identify areas of unique visual or vegetative quality, areas of historical significance, well known wildlife habitat and so forth. Six public meetings were held. Three were open specifically for members of other Town agencies (Planning Board, Historical Commission, Parks and Recreation, Board of Health, etc.) and three were held in the outlying 'neighborhoods' of the Town: South Middleborough, East Middleborough and North Middleborough. The intent in this case was to solicit first hand comments from residents, to establish a dialogue between the Conservation Commission and other Town boards, and to explain the scope and intended outcome of the plan for open space.

Plan For Open Space

From the potential open space map and from an increased understanding of Town goals through meetings, mapping and surveys, the RFS study team was able to arrive at a final plan for open space priorities. The plan shows existing open space areas and developed lands, areas proposed for new conservation, recreation and proposed linkages between designated areas. It was agreed by the Conservation Commission and the RFS team that (1) acquiring or preserving areas which can be used for both conservation and recreation is the best use of conservation funds and (2) it is more desireable to acquire, maintain and control contiguous areas rather than isolated pieces of land.

Implementation Strategies

The design of an open space plan is only half of the problem; implementation of the plan or any of its parts depends on legal, administrative and economic variables. Section 6 discusses specific tools for effective land acquisition and control, and attempts to suggest the most realistic techniques for the Town of Middleborough, given its values and political structure.

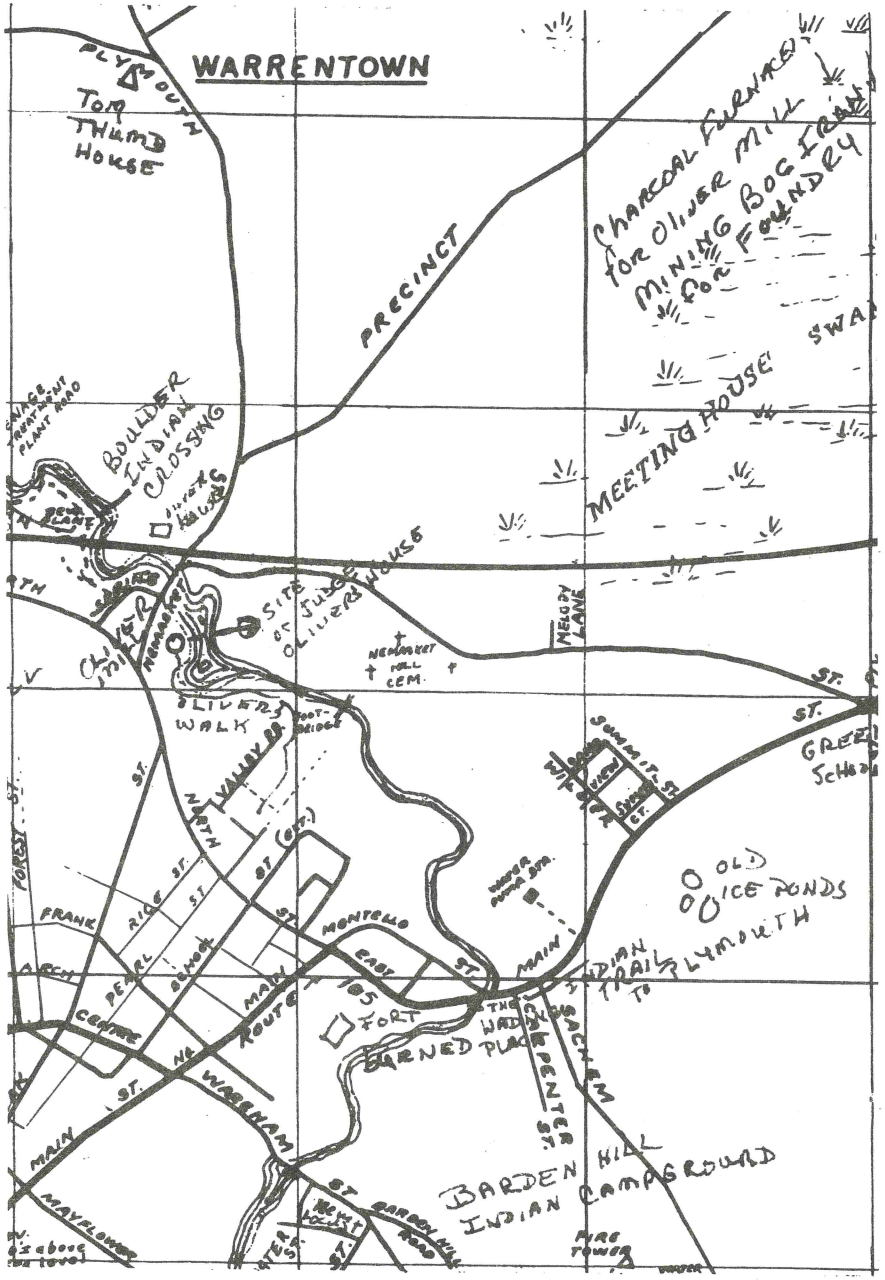


Figure 1: Resident-mapped Points of Interest in the Town of Middleborough

THE PLANNING PROCESS

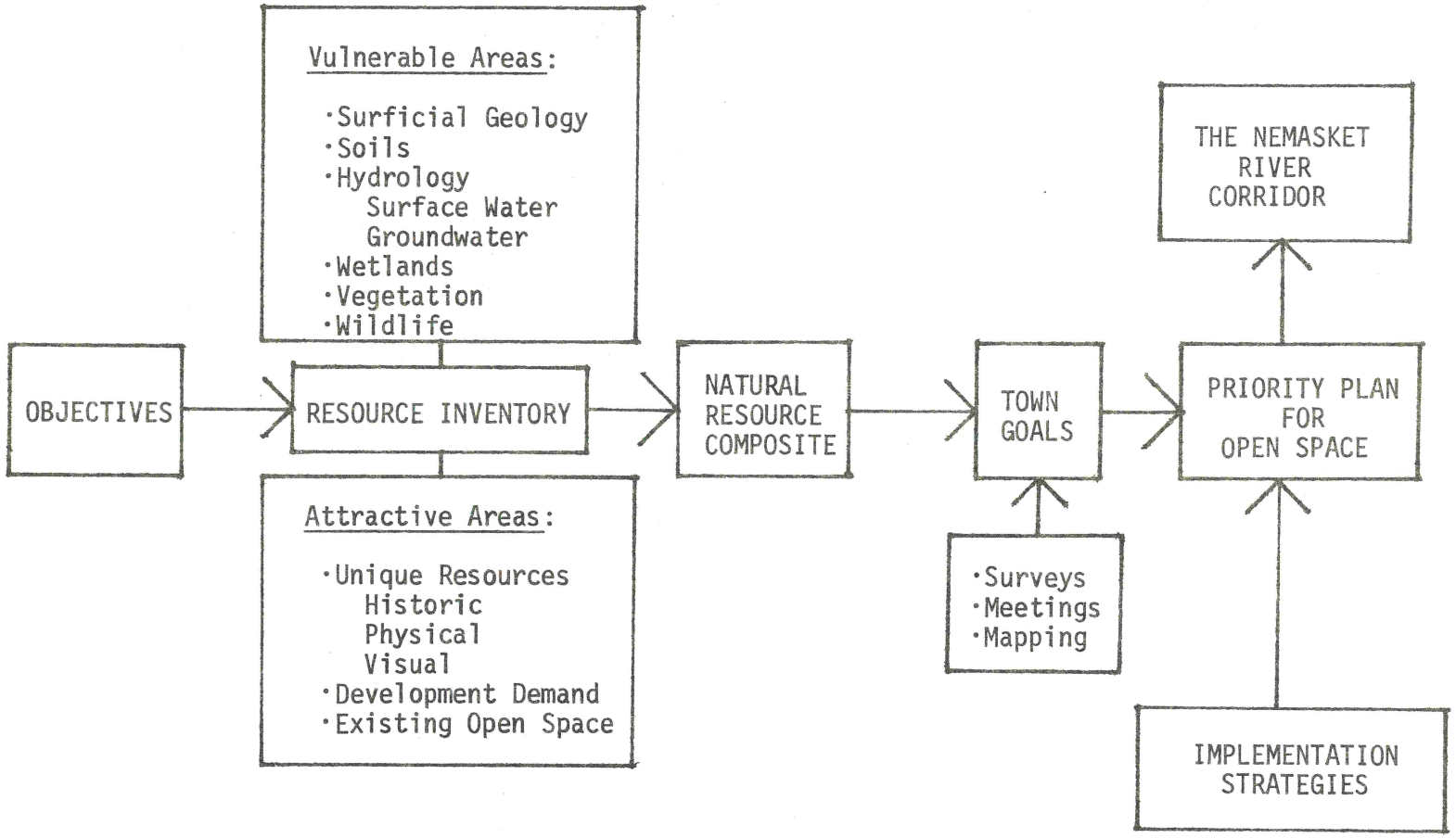


Figure 2: The Planning Process: A Flow Chart

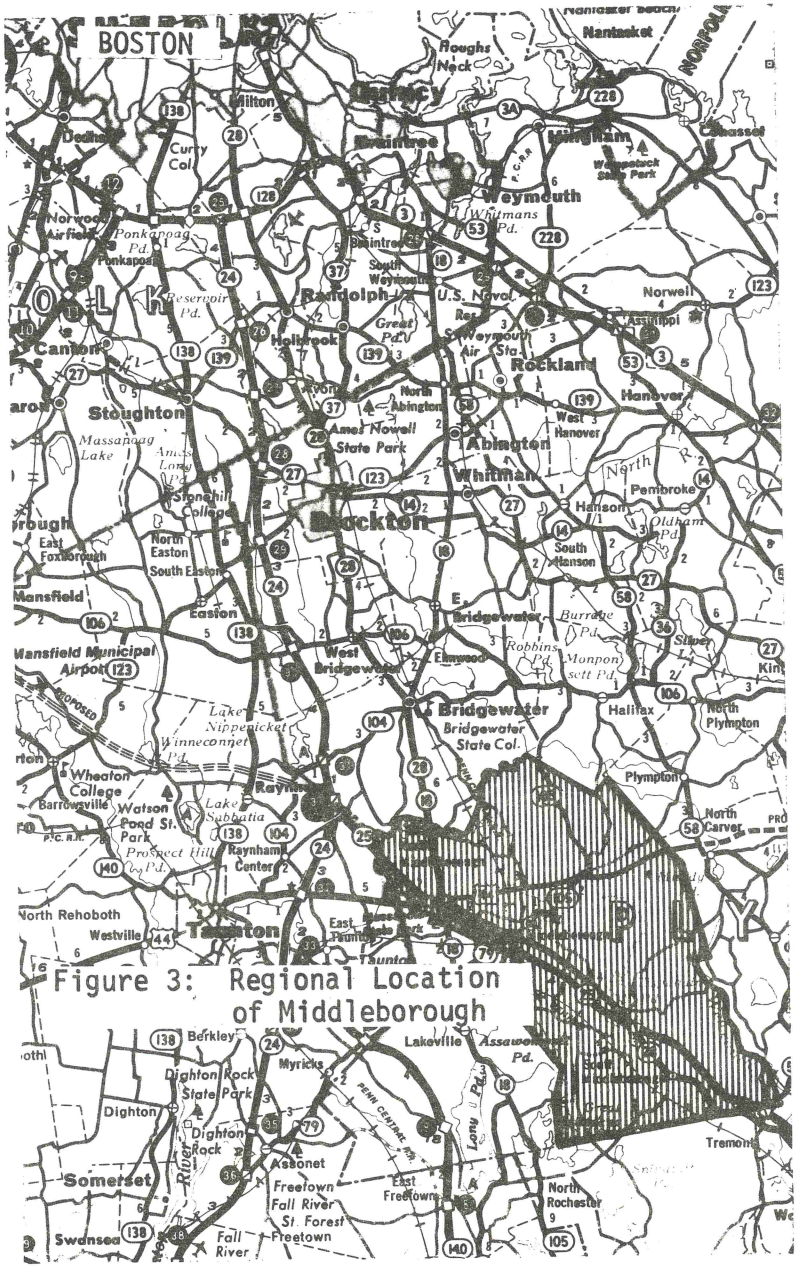


Figure 3: Regional Location of Middleborough

THE TOWN

Middleborough is located in southeastern Massachusetts, in the west central portion of Plymouth County. It has approximately 14,000 residents and has an areal extent of approximately 70 square miles, the second largest town (in area) in the State. Boston is 40 miles due north of Middleborough, and New Bedford is 20 miles to the southwest. The Town is bounded on the north by the Towns of Bridgewater, Halifax, Raynham and Plympton; on the east by Carver; by Rochester and Wareham to the south; and by Lakeville to the west. Middleborough lies within the Southeastern Regional Planning and Economic Development District for the State of Massachusetts.

Route 25, a limited access highway, passes through the western portion of the Town and connects Middleborough to the Route 24 development corridor and the Boston Metropolitan District. In addition, the construction of an extension of the circumferential I495 to Marshfield is expected in the near future. The proposed highway route would pass close to Middleborough's northern boundary, opening up what is now relatively undeveloped land. Development is on the increase within the Town because it now lies within commuting distance of Boston, Brockton and New Bedford.

Although Middleborough is classified as 'open' by the Massachusetts Department of Natural Resources' population standards, development pressure has caused considerable concern in the

Town. Precautions must be taken now to insure future environmental quality.

Because of its large areal extent, Middleborough has really four population centers, each with a distinct character and individuality; but all share the same resource base. Central Middleborough is the largest population center and it is located on Route 105 just east of Route 25. North Middleborough is an area with a rich historical heritage and it is located near the Taunton River between Routes 25 and 28. East Middleborough is central to the agricultural area of the Town which extends from central Middleborough to the Plympton border. It too has a rich historical background. South Middleborough is the most distant from central Middleborough and has therefore acquired a strong sense of community which revolves around the South Middleborough Grange and the South Middleborough Protective Association. Any plan for open space should consider the separate needs of these 'neighborhoods' as well as the needs of the Town as a whole. Therefore, the research team made a special effort to reach these areas in their public meetings.

Of equal significance to the plan for open space was Middleborough's place within its regional context. Where appropriate, the resources of Middleborough have been described with thought for their larger, regional implications. The Town is one of the few classified as 'open' in the rapidly urbanizing southeastern Massachusetts region, and as such has the potential to offer recreation and conservation lands to other towns. The study attempts to identify problem areas which Middleborough has in common with neighboring towns, and recommends cooperative effort to achieve regional goals whenever possible.

LAND USE HISTORY

Middleborough was originally the Indian village of Nemasket, and was subsequently settled by Europeans from the Plimoth Plantation of 1620. The Town recorded in the Plymouth Colonial Records on June 1, 1669, when "Namassakett shall be a township, and to be called by the name Middlebury...." Early colonial enterprises were subsistence farming, fishing and lumbering. With bog iron from its numerous swamps, Middleborough also had an early history of industry. By 1837 there were two forges, two cotton mills, three shovelmakers, an air and cupola furnace, and factories for the manufacture of nails, shoes, boxes and casks, and straw bonnets.

As land was cleared it was used primarily for pasture. Local beef and mutton supplied the urban markets until after the Civil War when the opening of the West brought about a decline in livestock farming. Pasture lands were allowed to revert back to forest. Farming on the field crops continued, but has rapidly declined. Much of the local industry has also relocated outside the area, and until Route 25 provided improved access to Boston, the Town experienced a period of economic decline. Recent demands for suburban dwellings and large sites for industries have begun to reverse the economic trend in the Town, but have put increased pressure on environmental issues.

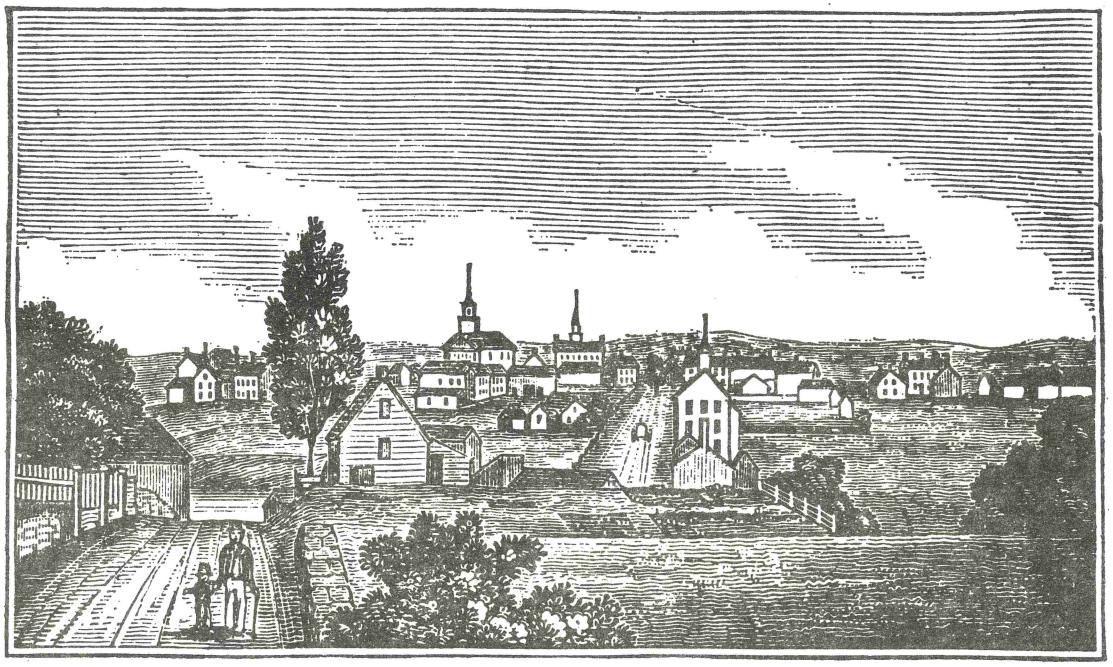


Figure 4: An Early Etching

2
RESOURCE INVENTORY

THE RESOURCE INVENTORY

The inventory of vulnerable resources follows the sequence of natural processes and attempts to describe cause and effect relationships between them. Climatological and geological factors are considered first because they provide the basis of the physical environment. The weathering of bedrock by climatic forces produces the topographical patterns of a region. From these can be made inferences about hydrologic characteristics, such as the location and movement of the surface water and groundwater. Topography and hydrology combine to determine the distribution and properties of the various soil types. Soil types, in turn, account for the occurrence and distribution of vegetative species. And, finally, plant communities are the basis for the occurrence of animal populations.

An understanding of the interrelatedness of all natural processes, a fundamental ecological principle, is necessary for the evaluation of any landscape for open space planning.

Attractiveness inventories for open space, such as historically significant or visually appealing areas, are also included as part of the Resource Inventory. It is felt that cultural, locational and visual criteria form an equally important part of the resource base of a town or a region.

CLIMATE

Middleborough falls within the coastal climatological division in Massachusetts due to its proximity to the ocean, its average elevation of 60 feet above mean sea level, and its gently undulating terrain. Winds prevail from the west, as is typical in middle latitude temperate climates, and they shift from predominately southwest in the summer to northwest in the winter. Three types of air masses affect the area: cold, dry air from the northwest; warm, moist air from over the Gulf Stream to the southwest; and cold, damp air over the Atlantic to the northeast.

The nearness of the ocean moderates climate factors in the region. The average annual temperature is 50 degrees. Summer temperatures range from 67° to 70°, with a maximum of 90° F. Winter temperatures range nearly 30° depending upon topographic location, and 34° F. is average. Precipitation averages 40 to 50 inches with local variations, and the area is somewhat drier than the western parts of Massachusetts. Annual snowfall ranges from 20 to 30 inches.

The growing season is about 180 days long, and combined with humidity, soil conditions and abundant water for frost protection, the climate particularly favors the production of cranberries as a cash crop. Middleborough is the home of Ocean Spray Cranberries Incorporated.

TOPOGRAPHY

Topographically, Middleborough lies within the Seaboard Lowlands region of the New England Physiographic Province where superficial characteristics relate to its history of glacial activity some 10,000 years ago. The area is one of relatively low relief with no more than 100 foot changes in elevation over the Town. Barden Hill at 191 feet above sea level is one of the highest points in the area. Many of the more prominent hills are underlain by large sand and gravel masses, while other similar landforms are composed entirely of glacial till.

The south-flowing Taunton River and the north-flowing Nemasket River provide the major drainageways for the region. Much of the Town, however, is very poorly drained, and swamps are common, particularly on low lying glacial lake sediments.

GEOLOGY

Surficial Geology

Northeastern North America was covered by as many as four major ice sheets during what was known as the Pleistocene Age in geologic history. The latest of these glacial advances, which occurred some 10,000 years ago, is referred to as the Wisconsin Stage, and it is presumably this activity that shaped the surficial geology of the Southeastern Massachusetts Region.

The Wisconsin Stage glaciers were actually three ice lobes which advanced southward from the Arctic, (Figure 5). The South Channel Lobe was the easternmost; it was influential in the formation of the outer portions of Cape Cod and Nantucket. The Cape Cod Bay Lobe formed to the west and deposited material which is now Cape Cod, Martha's Vineyard and Nantucket. The westernmost and most extensive ice lobe was termed the Buzzard's Bay Lobe, and it is this ice mass which was the major force in the formation of the surficial geology of Southeastern Massachusetts

Middleborough lies wholly within this region, and it is not far from the terminus of the final ice advance. Thus the landscape contains relatively more features associated with ice retreat than do areas further north. It is noteworthy that terms used in describing glacial features are arbitrarily limited, for in nature they grade from one to another without sharp boundaries.

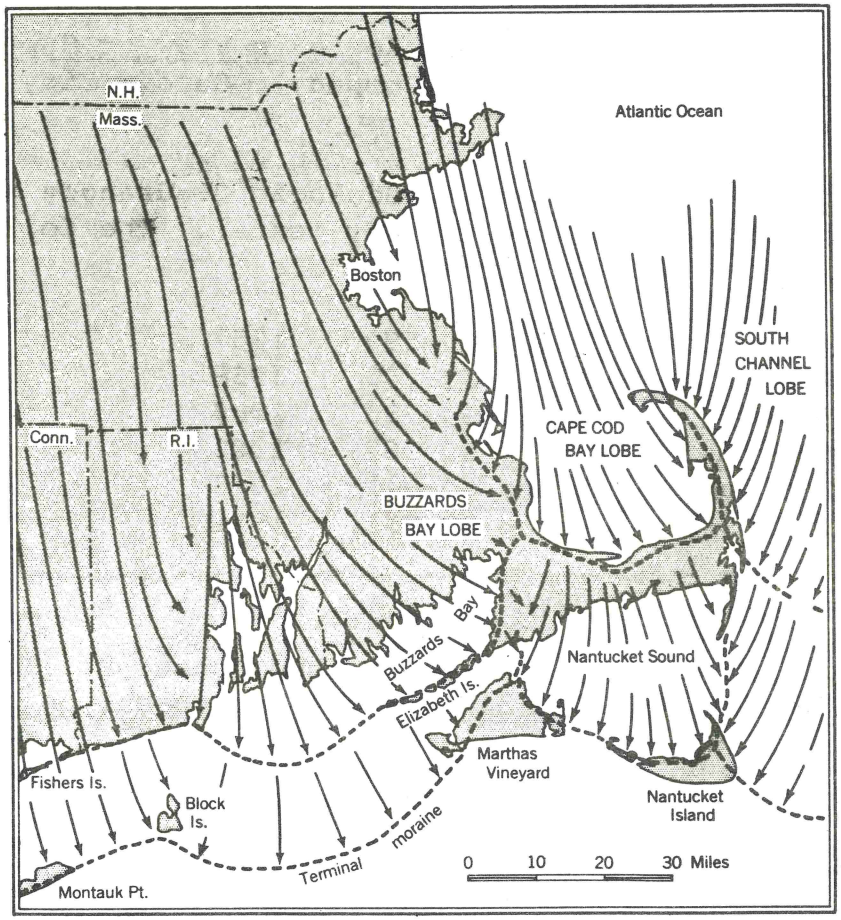


Figure 5: Direction of flow and location of major ice lobes during pleistocene glaciation. (From A GEOLOGIST'S VIEW OF CAPE COD, by Arthur N. Strahler)

As the glaciers moved southward over the region, they picked up soils, parts of frozen forests, and rock particles ranging from clay size to boulders. Some boulders were crushed to fine powder, rock 'flour', by the weight of the ice which was one-half to one mile thick in places. Other boulders survived and were deposited as glacial 'erratics' miles from their places of origin. The ice scoured grooves in bedrock outcroppings, called 'striations', which are aligned in the direction of ice movement. Direct evidence of this glacial abrasion is found on East Grove Street in Middleborough, where an outcrop of the Rhode Island shale formation shows striations oriented S 27°E. This outcrop is indicated on the surficial geology map. (Map 1).

South and east of Middleborough lies Buzzard's Bay end moraine, which delineates the edge of the last ice sheet, (Figure 5), the Buzzard's Bay Lobe. When the glaciers stopped at this point and began to melt, they deposited the rock and soil material which now covers the Town and which is termed 'glacial drift'.

Till and Ground Moraine

Unconsolidated glacial drift deposited directly by ice is termed glacial 'till'. It occurs in Middleborough as sharply delineated upland areas above a sea of stratified or layered drift. The regional landform is described as ground moraine; it lacks topographic expression of its own, and merely reflects underlying bedrock surfaces. Boulders of all sizes, predominantly from the Rhode Island shale formation, are scattered across the surface of this ground moraine.

The till of the Middleborough area, particularly toward the south, is described as englacial or superglacial in origin because of its loosely compacted and sandy nature. This indicates a lack of pressure from overlying ice and indicates that it was material pushed in front of the glacier. Glacial till varies in depth over the Town; in some places it has filled preglacial valleys and is more than 100 feet thick. In other areas the mantle of till is relatively thin and rests on unweathered rock which has entirely different characteristics.

Glacio-fluvial Deposits

Glacial drift which has been modified or transported by waters from a melting glacier is generally described as glacio-fluvial in origin. The distribution of such deposits in the Middleborough area indicate that many of these deposits were associated with local ice blocks which broke off the retreating glacier. The Great Ponds which border Middleborough to the southwest are thought to be remnants of glacial ice blocks whose drainage was blocked to the south by the terminal moraine of the glacier. The Nemasket River which drains these ponds thus flows northward to the lower lying area of the Taunton River channel.

The surface of the stagnating glacier was very hummocky. Rock and soil particles washed into hollows in the ice and, as the glacier continued to melt, finer particles were carried away while

sands and gravels remained. These were deposited as mounds or conical shaped hills called 'kames' which stand well above the surrounding topography. Barden Hill is an excellent example of this glacial landform.

Concurrently, small blocks of ice broke off the edges of the melting glacier and became buried by sediment. As they melted, the overlying soils collapsed and resulted in what are now kettle holes. Some of these remain as small bodies of open water, while others have filled in with swamp deposits. Kames and kettle holes combine to form what is called "knob and kettle" topography, (Figure 6). Rivers of meltwater in and under the glaciers carried large amounts of sediment, particularly sand and gravel. As their supply of water diminished, the rivers dropped their sediment load as long winding ridges on the landscape. These are called 'eskers' and Middleborough has several examples, (Figure 6).

Sediments which washed from the front of the glaciers in large areas uncluttered by ice blocks formed outwash plains. One such outwash plain occurs to the east of Barden Hill. Begining at the 120 foot elevation, it slopes gently to the south and east. The gravel pit between Sachem and Wood Streets presents a typical cross section of the upper 25 feet of the outwash, and shows the horizontally bedded sand and gravel. The surfaces of outwash plains are characterized by highly permeable soils.

Pitted outwash plains also occur in Middleborough, particularly in the southeastern portion in the

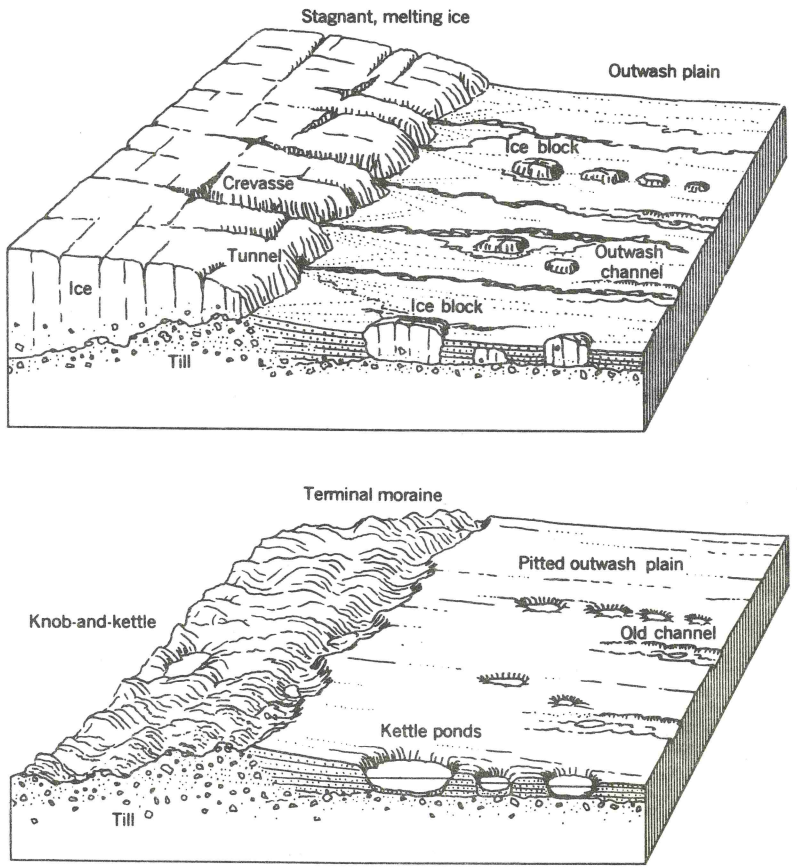


Figure 6: Formation of outwash deposits (above) and resulting landforms (below). (From A GEOLOGIST'S VIEW OF CAPE COD, by Arthur N. Strahler)

Weweantic River Watershed. These are areas of outwash which were either littered with ice blocks or subjected to continual reworking by subsequent meltwater streams. The resultant landscape is characterized by numerous pits and depressions. Pockets of sand and ponds in these areas have provided excellent cranberry bog terrain.

Lacustrine Deposits

A glacial lake nearly two miles wide existed, near the end of late glacial time, to the north and west of Middleborough center and extended almost to the Town of Bridgewater. The lake was backed up by ground moraine, kames and large ice blocks on the south, and it lapped the front of the retreating glacier on the north. The Taunton River, which now winds through the area, eventually drained the lake and is all that remains of the former lake bottom. Lake sediments include thick deposits of sands and clays, as evidenced by the clay pits and brick factory along River Street.

Post Glacial History

The retreat of the glaciers left the land barren. Wind activity, which occurred before the first vegetation appeared, deposited sand and silt on the surface of glacial drift in some areas. Plants began to colonize low areas, first in the form of tundra and bog vegetation; these are buried beneath present day swamp deposits. Modern streams have carved channels and have deposited alluvial material along their floodplains.

Bedrock Geology

Since relatively thick deposits of till and stratified drift cover most of the region, bedrock geology is known only by local outcrops which are few in number, (Surficial Geology, Map 1). The Dedham granodiorite and a diabase dike formation are of igneous (volcanic) origin. The Rhode Island Formation is of sedimentary origin. It is composed of sandstones and shales of the Carboniferous era and contains lenses of pebble and conglomerate. All of these formations outcrop in the northern half of Middleborough. Depth to bedrock generally ranges from 5 to 50 feet according to local well logs, although it is known to be greater than 100 feet in some areas.

Importance of Geologic Investigations

Geologic investigations are made as part of an open space study for several reasons. Perhaps the most significant is water resources. The arrangement and types of glacial deposits relates directly to the availability of groundwater. Outwash areas of sand and gravel are excellent aquifer recharge and groundwater retention areas. Ninety-five percent of Middleborough's water is found in unconsolidated glacial deposits. These same areas are generally characterized by highly permeable soils which make groundwater extremely susceptible to pollution if intensive development is allowed. A conflicting use of geologic information is the determination of mineral resource potential. Sand and gravel mining has been of great economic value to Middleborough. The many kames, eskers

and outwash areas are excellent sources of these materials. But it is important to know the location and function of sand and gravel deposits, especially in the context of future water supply, so that they will be mined wisely in accordance with long range values.

The geology of an area can be a clue to general soil types. As mentioned above, outwash areas result in droughty, sandy soils in relatively flat areas. Mineral soils with poor drainage result from glacial lacustrine deposits, while stony soils with hardpan are found in deposits of glacial till. A less quantative but equally significant aspect of geologic information is a description of unique visual and physical resources. Glacial topography with its undulating hills and valleys offers great interest and spatial variation to the landscape of the Middleborough region. It is relatively 'absorptive', in that it can accommodate human activity and settlement and yet maintain the illusion of a predominantly undeveloped area. Of course there are limits to this absorptive capacity. Particularly vulnerable are the hilltops; these should be protected from intensive development which can be seen from a great distance. Many of these hilltops offer regional vantage points and should be incorporated in an open space plan as overlooks and low intensity recreation areas. Barden Hill, again, is the most prominent example. Other kames, eskers and rock outcrops provide excellent tools for environmental education for Town residents and regional visitors alike.

Surficial Geology (Map 1)

Interpretation: Over 95% of the land surface in Middleborough is comprised of glacial deposits. Landform identification is valuable as a preliminary step in defining soil and vegetation types, locating mineral resources, understanding surface drainage and predicting groundwater availability.

Use: Combines with Groundwater Availability Map to identify areas potentially vulnerable to groundwater pollution; used to delineate unique physical resources such as kames, eskers and bedrock outcroppings.

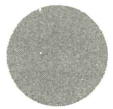
Sources: U.S. Geologic Survey Investigations for the Bridgewater and Assawompset Pond quadrangles; Plymouth County Soils Survey (1969); 1971 Air Photos.

Legend:

Moraine: widespread but discontinuous cover of till without distinctive landforms; very bouldery; some sand and gravel lenses

Outwash: sands to pebble and cobble gravel; undifferentiated landforms

Glacial fluvial: water laid and ice contact deposits; poor to well sorted sands, gravels, silts; kames and eskers

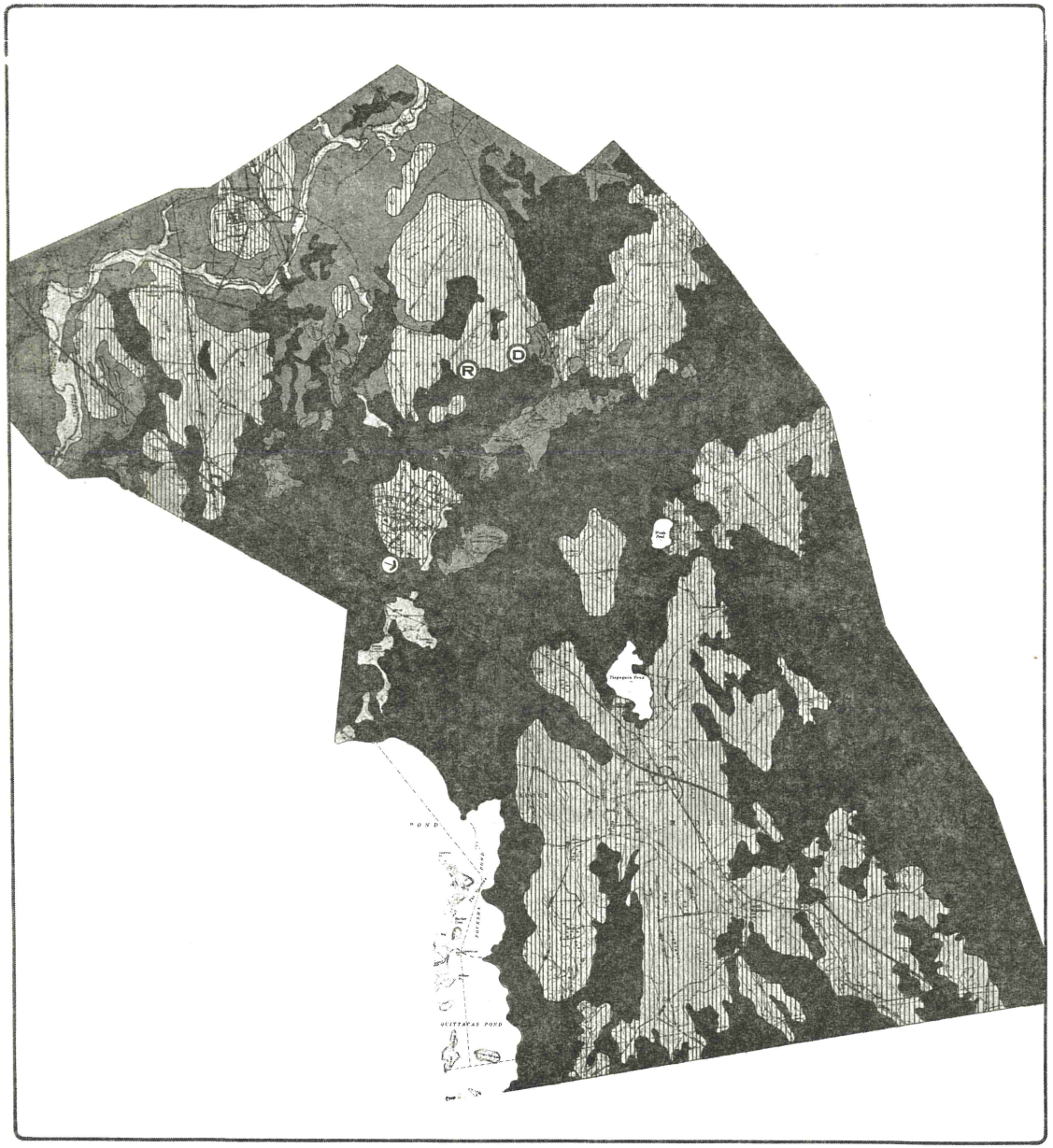


Glacial lacustrine: bottom sand, silt and clays of temporary glacial lakes; thin cover of glacial fluvial sands and gravels

Alluvium: clayey silts to coarse sands and pebbles deposited in the floodplains of modern streams; local beach deposits

Swamp deposits: muck, peat, silt and sand

Bedrock outcroppings of the Rhode Island Shale (R) and Dedham granodiorite (D) formations; arrow indicates direction of glacial striations



Middleborough Open Space Plan

Map 1: Surficial Geology

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

SOILS

A soil association is a landscape that has a distinctive pattern of soils. It normally consists of two or more major and at least one minor soil grouping, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern. Soil associations differ in slope, stoniness, depth and drainage characteristics. The natural properties of the soils of any area depend upon (1) its geologic history, which provides the 'parent material' for soil, (2) topographic relief, (3) climate, (4) living organisms, including man and (5) time. The differences between the soil associations of the Middleborough area can be attributed mainly to parent material and topography.

Soils are most often made up of three distinct strata. A cross section cut through these strata is called a soil profile. Each layer of the soil profile is called an horizon, and each displays different characteristics. The "A" horizon is the top layer of fine material and organic debris which is generally 2 or 3 inches thick over 6 inches to 1 foot of other fine grained material. It is low in mineral content because it is continually exposed to chemical and physical weathering and soluable materials are washed to lower layers. The "B" horizon begins at about 6 inches to 1 foot below the ground surface and extends from 18 inches to 3 feet in depth. It contains most of the dissolved minerals leached from the "A" horizon. The "C" horizon begins at 18 inches or 3 feet below the surface and extends to bedrock or other resistant material. This horizon generally contains the parent material of local soil associations.

There are many soil classifications, according to textural or engineering properties of the soil. For the purposes of this report, the Soils Conservation Service classification was felt to be most appropriate. This is a textural soil classification, whereby the distinctive appearance or feel of the soil, as well as the amount and distribution of fine and coarse-grained material, is used to differentiate soil types.

As noted in the previous section, Middleborough lies wholly within the glaciated part of North America. Therefore, glacial drift, comprised of bedrock particles from formations to the north, is the parent material of most of the soils. Soils formed in glacial till are generally much less permeable than those formed in glaciofluvial material, and are characterized by layers of hardpan. This is a natural cementing of soil particles by trickling groundwater with chemicals, particularly iron oxides, in solution. Residual soils formed in till often result in considerable amounts of dissolved iron in well water. The Essex/Gloucester/Scituate association is typical of soils formed from glacial till. Glacial-fluvial deposits weather to form droughty and well-drained sandy and gravelly soils. They are generally found on terraces and slopes greater than 15%. These are described by the Hinckley/Windsor/Merrimac soil association. On flatter areas, the same residual soils resulted from glacial outwash,

but are generally described by the same association because of their sandy and gravelly nature and drainage characteristics. Hinckley/Windsor/Merrimac soils are loosely structured and highly permeable. The loose structure makes these soils subject to erosion on steep slopes which are stripped of vegetation. The high rate of permeability permits rapid recharge of rainwater to the groundwater table; but also makes groundwater more susceptible to pollution from surface sources.

The Peat/Scarborough/Muck association contains poorly drained and very poorly drained mineral soils from glacial lacustrine deposits and organic soils from recent swamp deposits. These soils have a water table at or near the surface during most of the year.

Topographic relief, which plays an equally significant role in soil formation and distribution, is largely itself the result of glacial advances and retreats. The shape of the land surface, the degree of slope and the position of the water table have a great influence on the soils in Middleborough. Relief ranges from nearly level to moderately steep. On gentle slopes a large percentage of the percipitation enters the soil; on steeper grades, much of it runs off.

As a result, deeper soil profiles develop on gentler slopes and shallower profiles develop on steep slopes. The effect of slope and soil drainage is most pronounced in soils formed from relatively impermeable parent material (till). In gently sloping areas water is removed more slowly and soils commonly have features associated with temporary wetness. In depressions, even at higher elevations, water is removed so slowly that there remains a perched water table. This accounts for combinations of soil associations which are likely to contain both well drained stony soils and areas of very poorly drained soils.

In areas of pitted outwash, differences in elevation and depth to water table account for differences in drainage characteristics within the same soil association. The level of the water table does not fluctuate widely throughout the Town: it is generally found at 3 to 10 feet below the surface. Water percolates rapidly through the sands and gravels of residual outwash soils, but in areas of low relief the water table is so close to the surface that soils develop wetness features.

Additional Factors

The temperate, continental climate of the Middleborough region accounts for continual change with seasonal and daily fluctuations in temperature and percipitation. This results in an active weathering process particularly during the Spring and Fall when there are alternate periods of freezing and thawing. During this weathering process minerals, particularly carbonates, are leached from the upper soil horizons, creating a predominantly acid soil condition.

Plants, micro-organisms, earthworms and the activities of men account for local variations among soil types. Plants bring nutrients from lower soil layers and add their own organic

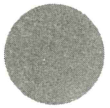
Soils (Map 2)

Interpretation: Soil is a primary determinant of land use and development costs. Intensive use of either droughty or poorly drained soils can result in adverse effects on ground or surface water supply. Soil types provide the basis for the occurrence and distribution of vegetative species.

Use: Provides basis for subsequent Soil Capability Map; combines with Surficial Geology Map to derive soil parent material; combines with Groundwater Availability Map to delineate potential groundwater pollution problems.

Sources: General soils mapping for Southeastern New England River Basins Commission, prepared by U.S. Soil Conservation Service (1972); Plymouth County Soils Survey (1969).

Legend:

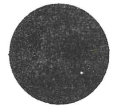


Droughty to well-drained sandy and gravelly soils on terraces and slopes less than 15%; formed in glacial outwash

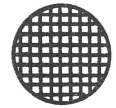
Droughty to well-drained sandy and gravelly soils on terraces and slopes greater than 15%; glacial fluvial in origin

Well-drained and moderately well-drained stony soils with hardpans on upland slopes less than 15%; glacial till

Poorly drained and very poorly drained mineral soils on level or nearly level slopes; glacial lacustrine (lakebed)

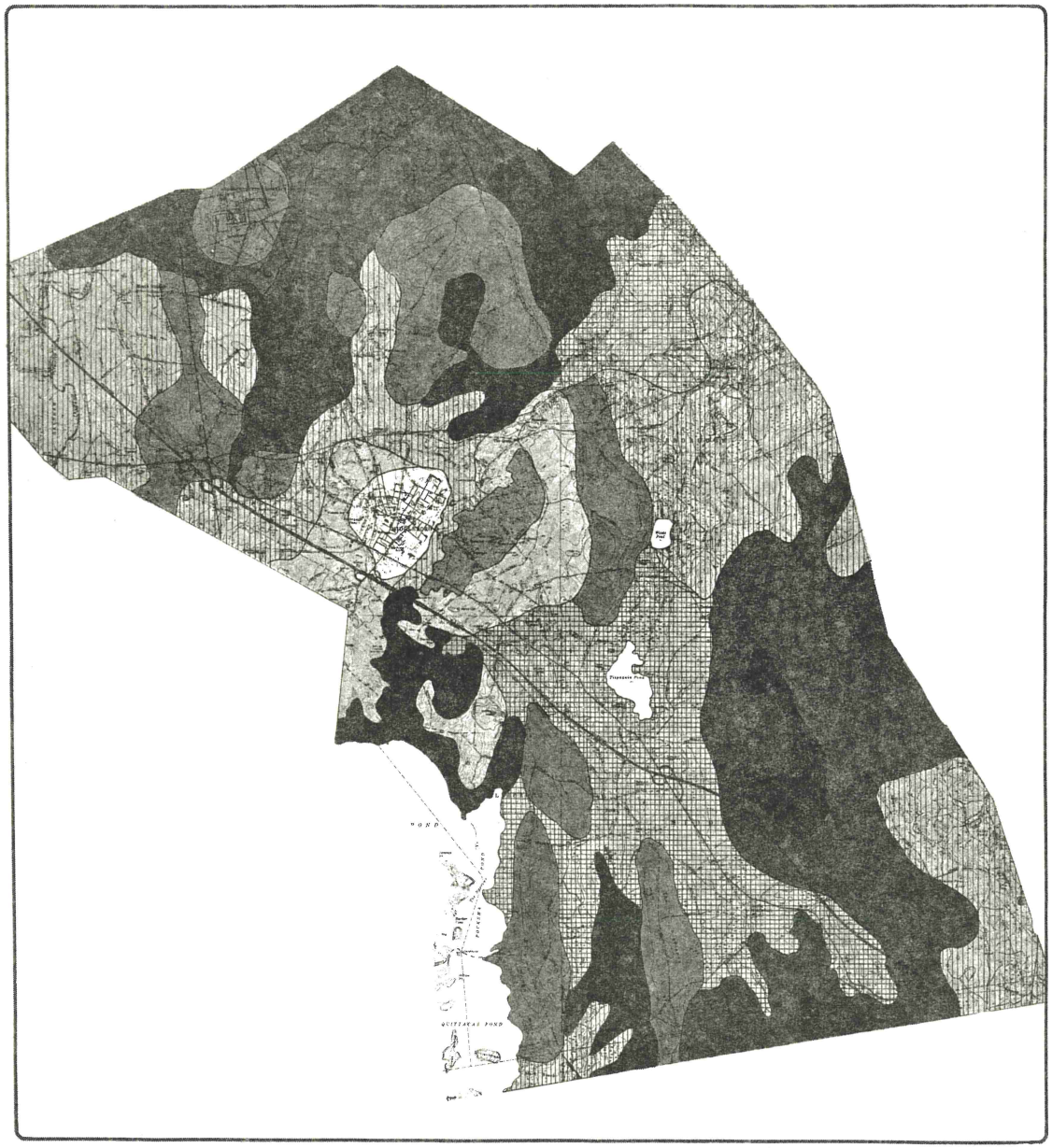


Very poorly drained organic soils; formed in recent swamp deposits



Well to moderately well-drained stony soils with hardpans, with areas of very poorly drained soils; glacial till

Droughty to moderately well-drained sandy and gravelly upland soils; poorly drained soils in areas of low relief; moraine (till) and outwash areas



Middleborough Open Space Plan

Map 2: Soils

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

material when they die and decompose. Plant roots provide channels to lower soil layers for air and water; this increases the weathering process. Men have cleared, burned, drained, cultivated, limed and fertilized residual soils thus producing many local physical and chemical changes.

The length of time that a soil is exposed to the weathering action of climate and organisms is significant in its degree of development. Soils in the Town of Middleborough have been exposed since the Wisconsin Stage of glaciation 10,000 years ago. Although this is a relatively short time geologically, it has been sufficient for distinct soil horizons to develop.

SOIL CAPABILITY

Comparatively little land in Middleborough is prime "developable" land (approximately 20%), but the new sewerage treatment plant will increase developable land by two and one-half times. In light of this, a Resource Inventory must seek to identify specific soils which must be acquired or protected for conservation or recreation purposes.

The Soil Conservation Service of the U.S. Department of Agriculture has published a complete soil survey of Plymouth County (1969) which includes detailed identification and mapping of the several soil types in the Town. The survey also includes a narrative description of local soils and their potential uses as well as interpretative criteria, or "capability classes", for specific uses such as agriculture.

Two of these capability classes are significant to this study. The first is Erosion Potential. This category includes soil types which, if surface vegetation were removed, would rapidly erode due to steep slopes or loose structural properties. These soils, particularly if they are adjacent to surface water bodies where the possibility of siltation is high, should be protected from intensive use. They are ideally suited to conservation or low intensity recreational use. Most of the soils in Middleborough are stable due to their structure and the predominantly flat topography. However, in areas of hilly moranic topography, some soils are likely to erode.

The second significant capability class is Playfield Suitability. Soils in this category occur in flat areas, with little or no surface stoniness. They are well-drained and relatively deep, with a surface suitable for turf maintenance. These areas are of particular value for athletic fields, playgrounds and other high intensity recreational uses. The outlying "neighborhoods" in Middleborough are particularly interested in the development of such facilities, and the Playfield Suitability classification can be used as a guide to site selection.

It should be noted that the Conservation Commission has the most detailed and accurate soils information and should be consulted for specific site recommendations.

Soil Capability (Map 3)

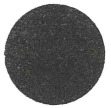
Interpretation: Soils in Middleborough are relatively stable due to their structure and the predominantly flat topography. Due to extreme stoniness or seasonally high water tables, large suitable sites for for playfields and intensive recreation facilities are not abundant.

Use: Combines with Surface Water map to delineate areas of potential surface water pollution; used with Existing Open Space to isolate areas for new intensive recreation facilities, especially in outlying areas of the Town.

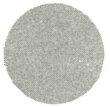
Sources: Plymouth County Soil Survey (1969).

Legend:

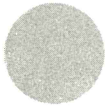
Erosion Potential: soil types which, if surface vegetation were removed, would rapidly erode due to steep slopes or loose structural properties



High Erosion Potential



Moderate Erosion Potential



Minimal Erosion Potential

Playfield Suitability: deep, well-drained soils, free from surface stoniness; suitable for turf maintenance; on level areas

Middleborough Open Space Plan

Map 3: Soil Capability

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

HYDROLOGY : Surface Water

The Town of Middleborough contains parts of two primary watersheds, the Taunton and Weweantic River drainage areas. The major watershed divide runs from the northeast to the southwest through the Town. (See Surficial Hydrology Map) Water flowing to the north and west empties into the Taunton River which flows south to Narragansett Bay. Water flowing to the south and east collects in the Weweantic River which empties into Buzzard's Bay. Within these major watersheds are several sub-watersheds which reflect local topographic irregularities. The most significant of these is the Nemasket River watershed which drains approximately 67.5 square miles. The river itself begins and ends within Town boundaries.

Three Great Ponds, Assawompset, Pocksha and Great Quitticas, border Middleborough to the southwest. Although they are the most outstanding Class A surface water bodies in the region, they are not accessible to Town residents. Frontage rights were sold to the City of New Bedford several years ago, and the area is presently restricted as reservoir land.[1]

There are two large, naturally occurring bodies of water within the Town: Tispaquin Pond and Woods Pond. The latter is surrounded by a considerable amount of development and is not well suited to recreational use because of its shallowness. Tispaquin Pond, although it too is relatively shallow, could be developed and managed as a Town beach area. Although the Fred C. Weston Town Conservation Land borders the pond on the north, much of the land is

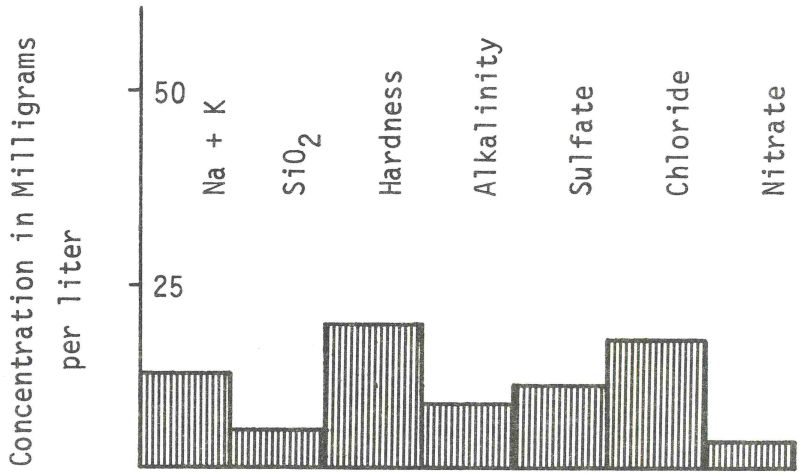


Figure 7 : Surface Water Quality

From USGS Hydrology Atlas #HA-460
Analysis of the Nemasket River

swampy, and access is a problem. The purchase of drier land adjacent to the pond has been defeated by the high cost of such property. Nonetheless, Tispaquin Pond has considerable potential and is a particularly attractive woodland/water amenity. The efforts to purchase or protect its edges should be continued.

Surface Water Quality

Presently the Taunton River which forms the northernmost boundary of Middleborough, and the Weweantic River on its eastern border are classified as Class "C" by the Massachusetts Division of Water Pollution

Control. This means they are suitable for recreational boating and that they can support wildlife and game fishes indigenous to the region. They are also suitable for industrial cooling and processing, crop irrigation, and they have appreciable aesthetic value. They can be used for water supply only with appropriate treatment.

The Nemasket River is also designated as Class "C" between Route 44 and the Taunton River. However, between Route 44 and Assawompset Pond to the south, the Nemasket is designated as Class "B." This portion is suitable for bathing and water contact sports as well as for agricultural use and industrial cooling. It is rated as excellent for aesthetic quality, but is acceptable for public water supply only with appropriate treatment. Unfortunately, the recreational potential of the Nemasket is now limited by periods of low flow during the summer months.

The chemical nature of surface water is important, even though Middleborough depends entirely on groundwater, because of the ultimate interconnection between the two systems. Figure 7 illustrates a low flow chemical analysis of the surface water at two gaging stations within the Town. In general, the concentrations of iron, manganese and color commonly exceed the limits recommended by the U.S. Public Health Service. This means that the streams would require some type of treatment before being acceptable as public water supply. Sediment and turbidity are low in most streams, except for brief periods during high flows. Chloride content has increased since it was first observed in 1890, presumably because of the increase in effluent from dumps, sewage wastes and runoff from heavily salted highways and streets.

Under natural conditions, the hydrologic systems of Middleborough are not severely affected by soil erosion and sedimentation, because vegetative root systems prevent soils from being washed away. With typical development practices, however, much vegetative stripping and earthwork takes place. These activities disturb the natural conditions which are necessary for soil retention. In an area where vegetation has been removed, water splashing on the ground in the form of precipitation infiltrates and saturates the soil. If soils are loosely structured, they will begin to run off with surface water. Siltation and sedimentation occur when soil particles, organic matter and soluable nutrients collect in gullies and flow into water bodies. This imbalance to the water ecosystem may seriously injure or destroy aquatic plant and animal life. A few degrees' change in water temperature can ruin aquatic spawning grounds and high turbidity rates can prevent the penetration of sunlight necessary for photosynthesis.

Flooding

Flooding is a natural characteristic of rivers; it is discharge in excess of channel capacity. River channels are shaped by the most frequent and moderate amount of discharge. Excessive discharge occurs irregularly and, since the channel cannot accommodate the increased amount of water, the river overflows its banks. Soil particles are carried with the overflow waters and are deposited as a floodplain. The floodplain is therefore part of the river system.

Surface Water (Map 4)

Interpretation: Areas subject to periodic flooding present hazards to life and property. All building should be restricted in these floodplains to prevent future loss as well as avoid siltation of surface water during construction operations. Floodplain zoning could be used to regulate intensive land use as well as provide a linear open space system along rivers and streams.

Use: Combines with Soil Capability map to determine areas of potential surface water pollution where highly erodable soils are adjacent to surface water bodies; map delineates approximate extent of 50 year flood levels.

Sources: U.S. Geologic Survey Hydrologic Investigations, Atlas HA 460 (1973); Southeastern New England River Basins Commission mapping for the Taunton River watershed.

Legend:

Floodplain

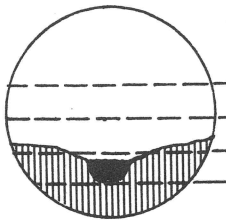
Surface Water

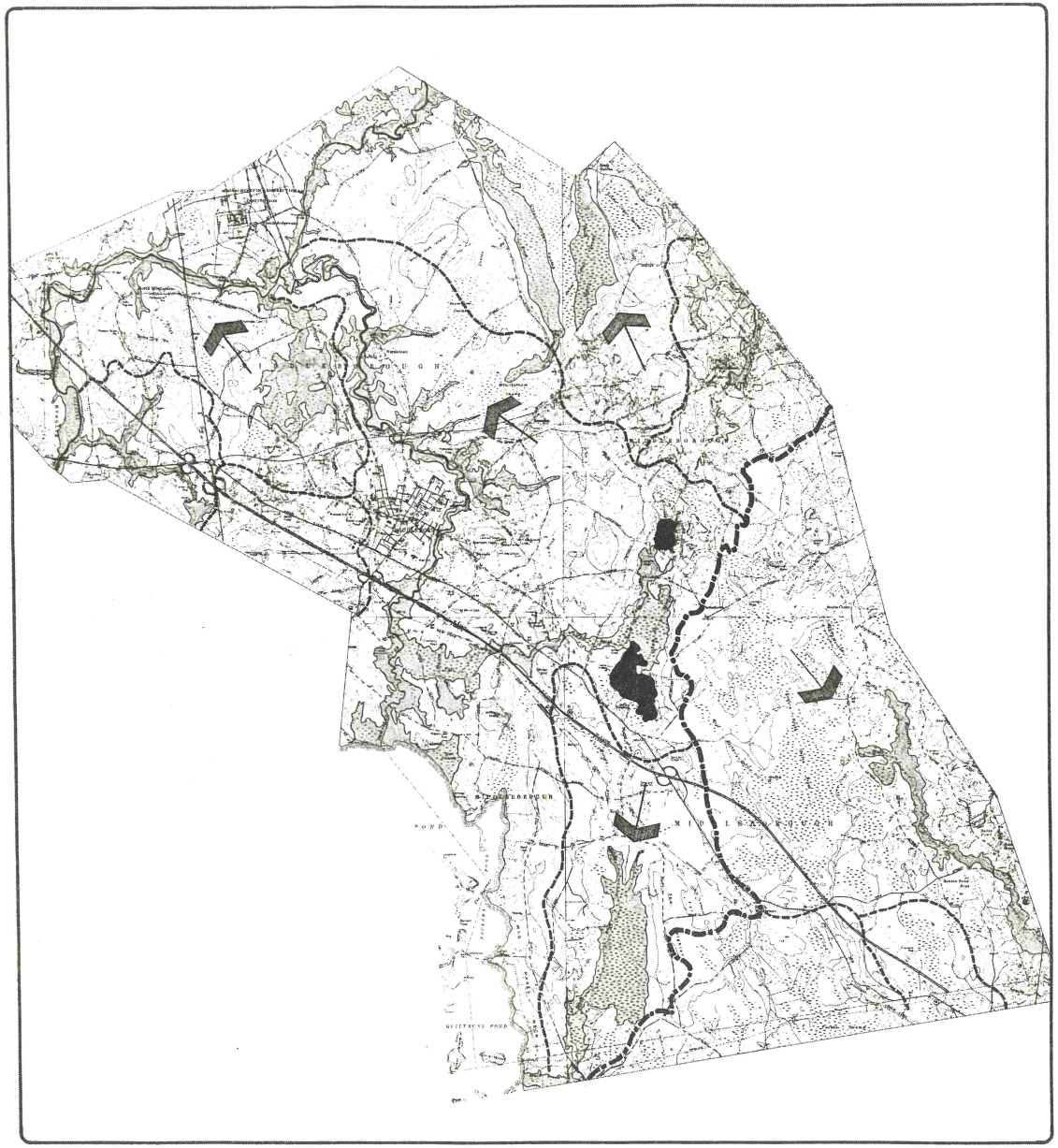
Major Watershed Divide

Sub-watershed Divide

Direction of Flow

FLOOD DATA: FALL BROOK GAUGING STATION


59.0 Elevation max. observed flood
58.4 Computed 50 year flood
57.5 Computed 2.33 year (mean annual)
55.0 Gauging station base level



Middleborough Open Space Plan

Map 4: Surface Water

10 square acres

1 square mile

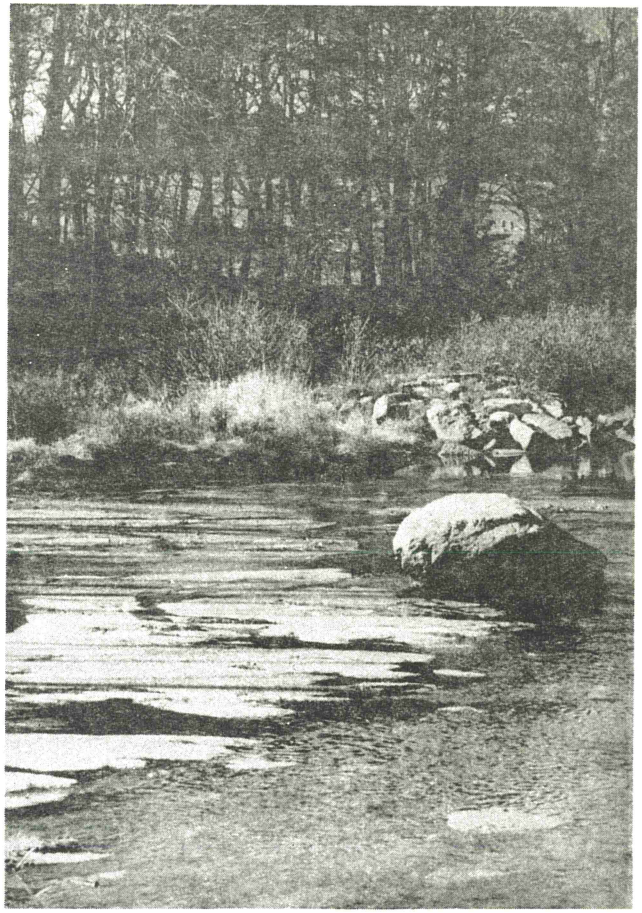
0 1 2 3 4

scale in miles

north

Approximately twice a year, enough rain or snow-melt occurs to cause the level of water to achieve a "bankful", not a "flood" level. Less frequently are 2, 10, 50 and 100 year flood levels. Although floods are not a major problem in Middleborough due to low gradients and local wetland storage capacity, construction and even agricultural activities should be restricted on river floodplains. The Surface Water Map delineates the 100 year floodplain in the Town. The Army Corps of engineers recommends land use restriction within the 100 year floodplain to prevent loss of life and property as well as to insure water quality. River floodplains, when undeveloped, offer potential linear recreation areas; golf courses, picnic areas, hiking trails and canoe launch areas would be compatible uses. In addition, the view of the river and the view from the river are protected by restrictions on floodplain development.

Southeastern New England is characterized by extreme fluctuations in seasonal stream flow, and this impairs both water quality and water quantity. Major population centers like Middleborough, which are situated on surface water bodies, have a responsibility to protect critical water resources such as the Nemasket River, the Weweantic River or Tispaquin Pond, as part of their planning process.



The Nemasket River

[1] In 1924, the Massachusetts State Legislature granted water rights to the Great Ponds to the cities of Fall River, New Bedford and Taunton, ending 20 years of litigation by the Town of Middleborough to maintain control; as a result, Middleborough residents can neither regulate the flow of water into the Nemasket River or enjoy recreational access to the ponds and shorelands.

HYDROLOGY: Groundwater

Water that lies beneath the ground surface, fully saturating the enclosing soil or rock material is termed "groundwater." The surface zone occupied by groundwater is known as the "zone of saturation", (Figure 8). If a well is dug sufficiently deep to penetrate the zone of saturation, water will stand at a level which marks the "water table", that is, the upper surface of the groundwater body. Above the water table lies the "zone of aeration" in which the pore spaces of soil or rock normally contain both water films and air. Water in this zone is called "capillary water", since it clings to mineral surfaces of soil or rock by capillary tension; it is thus able to resist the forces of gravity.

Groundwater does not remain static if the water table is higher at one place than another. The path of movement of groundwater will be in the compass direction from the higher to lower points on the water table. Flow paths need not descend continuously. They are influenced by local configurations of glacial deposits and bedrock, and many travel uphill for short distances due to capillary tension and confining pressure. This accounts for the fact that the water table elevation is often higher under a hill than in an adjacent lowland. Streams, ponds, lakes and wetlands are most often expressions of the water table at the ground surface, unless a layer of impervious material (clay or bedrock, for example) has caused the water to be "perched" above the natural ground water table. Flow in streams is fed largely by seepage from the groundwater table or by the outflow of ponds at the water table.

An "aquifer" is a layer of material which contains and transmits a usable supply of water. The transmissivity of an aquifer is directly related to the porosity of the soil or rock material. For example, a clayey silt which has very tiny pore spaces between particles will not transmit, or give up, water very readily; on the other hand, a coarse sand, with larger pore spaces will transmit water freely and rapidly.

A "recharge" area is a layer of permeable soil material close to the earth's surface through which water can enter an aquifer. It is usually higher in elevation than the aquifer area so that water moves through the system by the force of gravity. In some areas, but not generally in Massachusetts, recharge areas may be separated from an aquifer by many miles. A groundwater "reservoir" is a subsurface location which collects groundwater; it is synonomous with the zone of saturation.

The primary advantages of a groundwater supply are that water quantity is not lost to evaporation, and that water quality is not jeopardized by sedimentation. Southeastern Massachusetts has water table conditions, that is, water is recharged locally and is more immediately responsive to local precipitation; it is also more immediately responsive to local pollutants.

Not all surface water and precipitation contributes to groundwater recharge. In the Northeast, only about half of the annual precipitation becomes groundwater. The other half is returned to the atmosphere by evaporation from ground surfaces and

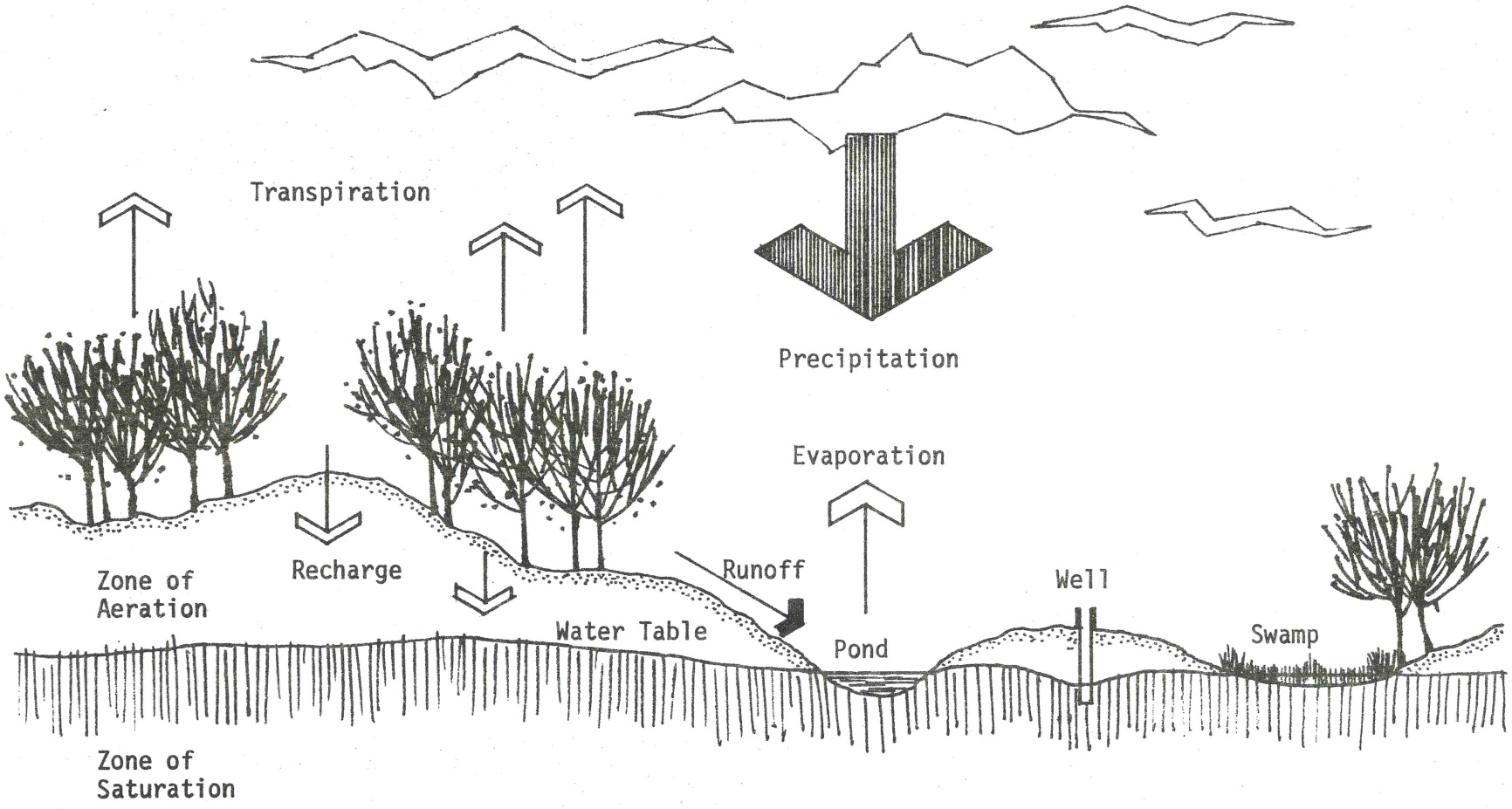


Figure 8: THE HYDROLOGIC CYCLE

transpiration by plants. Hydrologists refer to the total amount of precipitated water returned to the atmosphere by these two processes as "evapotranspitation." Therefore, precipitation, minus evapotranspiration, equals the seasonal water surplus, or the "water budget."

In some areas, part of the water budget is lost when surface runoff is not able to penetrate the soil as rapidly as it is received because of impervious soil conditions or extensive paved surfaces. This water moves downslope in a thin layer and enters the nearest stream channel, by which it is transported out of the region.

Groundwater in Middleborough

The principal aquifer system in the Middleborough region is stratified, unconsolidated glacial drift, consisting of gravel, sand, silt and clay which have accumulated in valley and lowland deposits. These deposits are underlain by till and bedrock which also form many of the hills bordering the aquifer.

The Groundwater Availability Map shows the distribution of high, medium and low yield zones, and is based on the estimated transmissivity calculated from test wells and borings by the U.S. Geologic Survey. Transmissivity values range from less than 1,000 gallons per day per foot in thin stratified drift near the margins of the aquifer and in fine-grained lake deposits, to about 400,000 gallons per day per foot in thick, coarse sand and gravel.

In all parts of the aquifer system, local variations in the texture of the stratified drift effect the thickness of the aquifer. These differences may result in lower or higher yields than indicated on the map. Test drilling is needed to specifically locate the most productive parts of the aquifer. Proximity to sources of pollution (dumps and sewage disposal sites) must also be considered in locating well sites. Till has such a low transmissivity rate that it is not considered an aquifer; however, local wells in till can provide domestic water supplies.

Middleborough has not escaped a noticeable lowering of its water table, even though widespread domestic use has dispersed sources of water withdrawal, and septic systems have returned used water close to the point of extraction. If development proceeds as usual, Town water will be taken from the same groundwater reservoir, but it will be piped out of the region in sanitary sewer and storm drainage systems. In addition, as paved surface areas of a town increase, permeable surfaces, which once served as recharge areas, are lost. The water table will continue to fall in Town well areas if the withdrawn water is piped out of the area and if adjacent recharge areas are not protected.

Groundwater Quality

Because all of Middleborough's water comes from groundwater sources, its quality is of primary significance. Salts, sulphur and iron can make it taste unpleasant; calcium and magnesium will make it hard and will gray clothing that is washed in it. Chemicals are taken into solution by rain as it falls through the atmosphere, and by groundwater as it moves through rocks and soil. Small amounts

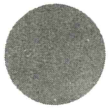
Groundwater Availability (Map 5)

Interpretation: Groundwater reservoirs appear to be located in pre-glacial drainage basins which closely align with the present Nemasket River drainage channel. The map indicates areas of groundwater availability in terms of gallons per minute. Extensive development should not occur in high yield areas associated with high water tables and highly permeable soils because of potential groundwater pollution. In addition, paved or other impervious surfacing increases runoff and prevents local recharge in these areas.

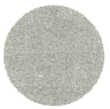
Use: Combines with Geology and Soils maps to indicate groundwater contamination potential; combines with Wetlands map to establish relative recharge value of specific wetlands.

Sources: U.S. Geologic Survey Hydorlogic Investigations, Atlas HA 460 (1973); Massachusetts Water Resources Commission, Basic Data Reports, No. 12 and No. 7 (1970); Southeastern New England River Basins Commission, Taunton River data inventory.

Legend:

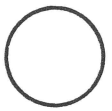


Groundwater reservoir and recharge areas; stratified glacial deposits capable of yielding 300 GPM or more; recharge potential is rapid except in swampy areas; surface runoff is expected to be moderate to low; groundwater highly susceptible to contamination entering from land surface (even in swampy areas) within 4000 feet of wells

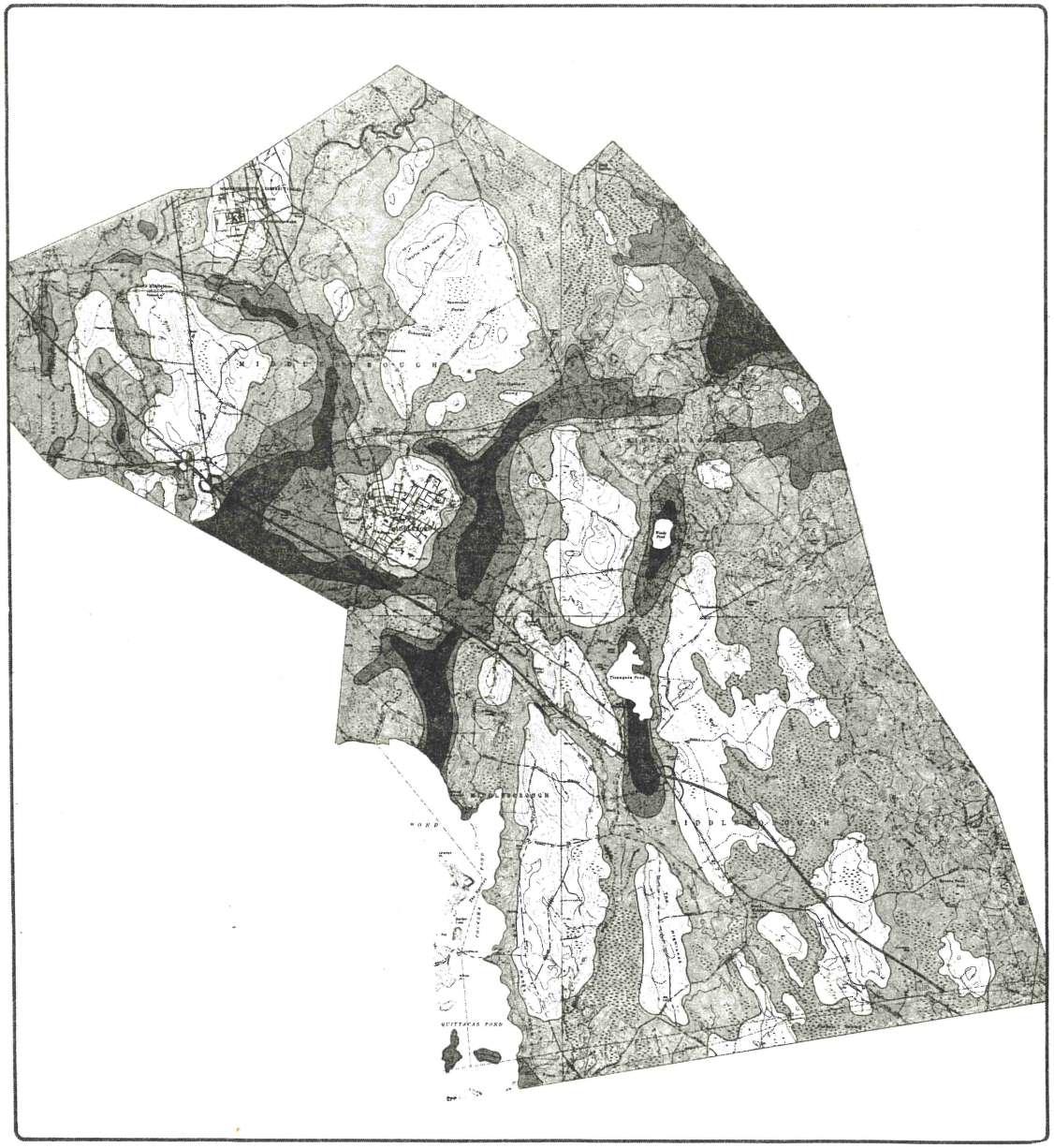


Groundwater recharge areas; stratified glacial deposits yielding less than 300 GPM; recharge varies between rapid and moderate; slow in swampy areas; surface runoff is low to moderate, contamination may readily enter the ground from land surface except in swampy areas

Stratified glacial deposits either thinner or less water conductive; yield is less than 100 GPM; surface runoff and contamination potential vary widely; low recharge rates expected in swampy areas and lowlands with surficial deposits of silt and clay; high recharge and contamination potential in uplands and hillside areas



Areas of till and bedrock which are unfavorable for well sites; yield is more than 25 GPM; contaminated water may run off these areas onto adjacent permeable surfaces, however; slow recharge and high runoff



Middleborough Open Space Plan

Map 5: Groundwater Availability

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

of chemicals therefore occur naturally in groundwater. But chemicals also enter the water as a result of various land use activities: industrial wastes, highway salts, septic effluent, chemical fertilizers and pesticides, particularly from cranberry bogs. Figure 9 depicts groundwater quality in Middleborough which, at the present time, does not appear to be in jeopardy. But the long term combined effects of pollutants are not known.

In some areas, the soils can be depended upon to protect potential water supplies until they are needed, by acting as filters for larger polluting particles or by providing bacteria to break down organic pollutants. But this would require a minimum of ten feet of soil depth to insure proper cleansing, and the average depth of the soil between the ground surface and the water table in Middleborough is only 3 to 10 feet. Therefore, high yield aquifer areas, particularly those which underlie well-drained or highly permeable soils must be restricted from intensive development. Conservation or low intensity recreational use of such areas would be compatible with the protection of water resources.

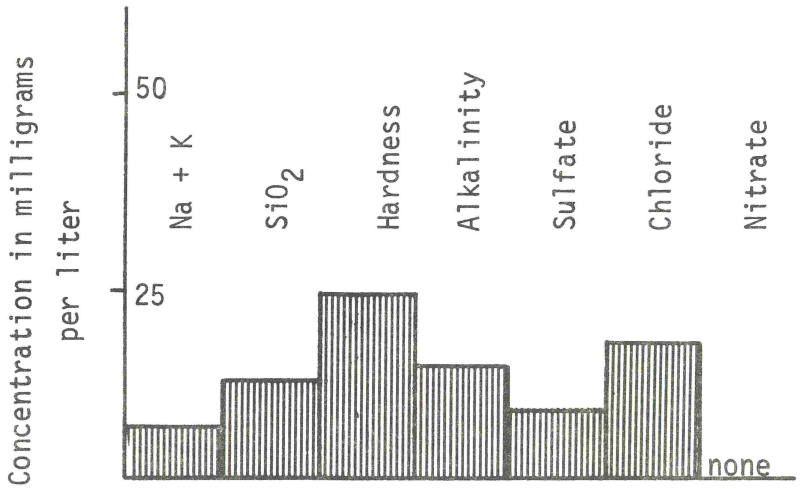


Figure 9 : Groundwater Quality

From Clay Street test well #MBW-171, Town of Middleborough

WETLANDS

Wetlands have been one of the least appreciated components of our environment. Land values have traditionally regarded them as waste areas. Their natural progression from open water to forest, known as "hydric succession," requires thousands of years; but men can drain or fill them overnight. Only recently has the public become aware, with increased support from the courts, of the value of freshwater wetlands for water supply, flood control, recreation, open space conservation, education, wildlife habitat and scientific research.

During the last few years, several states, including Massachusetts, have enacted legislation to control alteration of wetlands. (Chapter 131, Section 40 of the Massachusetts General Laws) Unfortunately, implementation of these laws has been unsuccessful, partly because decision-makers at all levels lack appropriate criteria for evaluating the comparative importance of wetlands.

At least one third of the Town of Middleborough could be classified as wetland. The area is under continuing development pressure, both residential and industrial. Such development would alleviate the relatively heavy local tax burden. In addition, plans for a tertiary sewerage treatment plant are now underway. This will make formerly non-septicable soils suitable for development. The Town can neither afford to buy all its wetlands, even at the common price of $250 an acre, nor can it rely on existing legal mechanisms to protect its most significant wetlands. Local measures of sensitivity are not built into the legislation; agricultural exemptions in the law have allowed the most serious wetland losses to date.

Obviously, choices must be made. It is difficult, however, to determine the level of protection which exists or which is necessary. An alternative to the present situation is that the Town establish some wetland priorities and use every available strategy to secure the most significant lands. A secondary measure that the Conservation Commission could undertake as the local enforcement body, would be the establishment of specific standards for measurable effects of filling or draining wetlands. Such standards might gauge increased runoff, flood discharge or soil erosion; no standards are delineated within the wetlands statute.

In lieu of a detailed wetland analysis, which is not within the scope of this study, the following are recommended as evaluative wetland criteria.

Definition

Wetland definition presents a major obstacle to the implementation of recent legislation. Many different definitions exist: some are based on botanical classification, others are determined by hydrologic characteristics, and still others depend on soils criteria. Differing legal interpretations have compounded the problem. Physical boundaries between wetland and non-wetland areas are not clear cut; they may even change from year to year. Since legal wetland delineation puts restrictions on private property, it cannot

realistically be based on a changing definition. No one is eager to make the final decision. At this time in Massachusetts, wetlands must be delineated on town assessor's maps in order to be legally binding. This process has been completed for very few towns within the State.

In general scientific terms, a wetland is any piece of land which is covered with shallow and sometimes temporary (seasonal) surface water from six inches to ten feet in depth, and which consists of any of the soil types designated as, but not limited to, "very poorly drained" by the Soil Conservation Service. The latest State bill regulating the protection of wetlands defines the term "freshwater wetlands" as "wet meadows, marshes, swamps, bogs (and) areas where groundwater, flowing or standing surface water or ice provide a significant part of the supporting substrata for a plant community for at least five months of the year; (and) emergent and submergent plant communities in inland waters; (and) that portion of any bank which touches any inland waters." (Senate Bill 1842; July, 1974)

Wetlands are divided into eight major types on the basis of average water depth, degree of seasonal flooding and dominant vegetation type. Vegetation types, and examples of each, are: (1) trees, red maple; (2) shrubs, alder; (3) emergents, cattail; (4) surface plants, duckweed; and (5) submergents, water milfoil, (Figure 10).

Wetland classes include: (1) Open Water, water from 3 to 10 feet in depth which borders on other wetlands but has no emergent or woody plants; it may have water lilies or submergents; (2) Deep Marsh, water from 6 inches to 3 feet in depth with

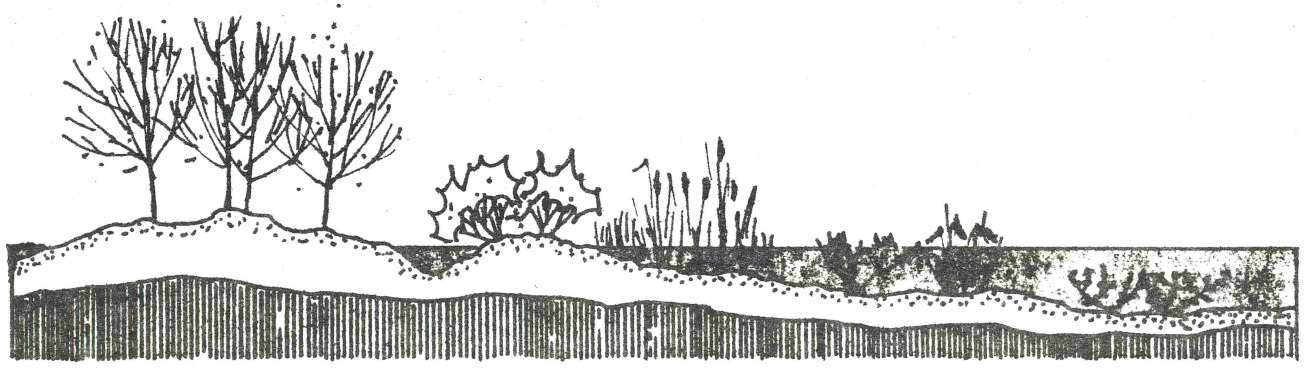


Figure 10: Wetland Vegetation Types

predominantly herbaceous or non-woody plants; may have some areas of open water; muck soils; (3) Shallow Marsh, water less than 6 inches deep during the growing season, with predominantly herbaceous or non-woody plants; vegetation is more dense than in a deep marsh; muck soils; (4) Seasonally Flooded Flat, river floodplains where annual flooding depth may reach 12 inches; grasses and sedges are the predominant vegetation type, but trees and shrubs may be present; (5) Fresh Meadow, areas of groundwater seepage not associated with surface water; grasses, rushes and sedges dominate, and soils are saturated; (6) Shrub Swamp, seasonal or permanent water table to 12 inches; dominated by woody (shrub) vegetation; small areas of open water and tussocks of sedges are often present; muck soils; (7) Wooded Swamp, seasonal or permanent water table between 12 and 15 inches; woody (tree) vegetation on hummocks is dominant, but shrubs may be present in the understory; muck soils; (8) Bog, an accumulation of sphagnum moss as a floating mat; peat soils; usually no major stream outlet.

Hydrologic Role

The exact association between wetlands and the groundwater system is not clear, but is the subject of much recent investigation. All wetlands do not have the same degree of vulnerability to change. Formerly, it was assumed that the rate of percolation through muck or peat deposits was so slow that the recharge connection between wetlands and other parts of the water table was insignificant. The complex nature of the surficial geology of New England, however, has caused some skepticism of this theory. It is now postulated that a wetland which occurs in conjunction with underlying permeable material (glacial outwash, for example) is more vulnerable because surface contamination, in excess of its normal load, or the puncturing of the peat or muck layer will directly effect the groundwater system. Conversely, if the underlying material is more impervious (glacial till, for example), the danger of contamination of the groundwater supply is greatly reduced. Evidence at this point is inconclusive, and subsurface site investigations are needed to determine the role of each wetland in relation to groundwater recharge.

Other hydrologic functions of wetlands can be assumed, however, by the site location of a wetland. Topographically, a wetland can be situated in either an upland or bottomland. Upland sites are those which lie above stream valleys and floodplains; most of these occur in small pockets of bedrock or till, and the water table is usually "perched." Bottomland sites lie chiefly in the alluvium of stream floodplains, on outwash plains or on glacial lake beds, and they are generally associated with regional water tables. Because of their sustained water levels, they have a greater life expectancy, and are more biologically productive. They are therefore more valuable.

The hydrologic position of a wetland may be lakeside, stream-side or it may be isolated. An isolated wetland does not border any large water body. It owes its wetness as much to groundwater seepage and surface runoff as to stream flow, and it is therefore not as valuable as a wetland associated with open water. Stream-side wetlands make up parts of the floodplain of a river or

stream, and lake-side wetlands, of course, occur along lake margins.

Bottomland lake-side or stream-side wetlands, therefore, have the highest priority because of their apparent connection to regional water systems and their potential flood storage capacity. Isolated bottomland sites would be the next highest in priority, followed by upland lake-side or stream-side, and finally isolated upland sites.

Inland wetlands are the main source of floodwater storage in New England. A 6 inch rise in water over a 10 acre wetland places more than 1,500,000 gallons of water into storage with no harm to surrounding biota. Loss of this retention capacity through dredging or filling will result in higher future flood levels and greater threats to life and property, particularly in downstream areas. Most susceptible, as indicated above, are the lake-side and stream-side wetlands, which, when filled, reduce the basin or channel capacity to carry or store flood waters. Increased erosion and sedimentation result, and bridge openings and culverts are no longer adequate to deal with the additional runoff. The cost of rebuilding such structures is not small.

It is in this context that the wetlands laws offer the greatest potential for local control. The Town, through the Conservation Commission, has the authority to establish performance standards which every applicant must address when he petitions for a permit to dredge or fill a wetland. Chapter 131, Section 40 of the Massachusetts General Laws states, in relation to storm drainage, that there shall be no "appreciable increase in runoff rate (or volume) as a result of the proposed activity," and that "calculations must be submitted and be ..for a 50 year intensity storm." The Soil Conservation Service has recently developed a simplified method for calculating runoff before and after proposed development. It is known as the Modified Soil Cover Complex Method, and it can be easily learned and applied at the local scale to establish quantitative criteria for wetland protection.

During periods of low runoff, wetlands are of equal importance because they gradually release stored water and help to maintain stream flow. During dry weather this flow helps to prevent stagnation, to maintain water quality for recreation, and to enhance fish and wildlife productivity and habitat.

Wetlands also serve as pollution filters. They contain many plant organisms which feed on impurities and break them down into harmless elements. The nutrient load, which causes algal bloom in polluted waters, is reduced and oxygen levels are increased. Of course there is a limit to this filtering capacity of wetlands; concentrations of pesticides, fertilizers, salts and similar elements build up over time. The algae begin to dominate the vegetation system and, since algae cannot break down impurities, eutrophication sets in.

Biological Productivity

Plant forms in wetlands relate primarily to wildlife value. The diversity and nature of plant forms are a key to wildlife diversity. Basic habitat requirements of all wildlife species include

food, nesting and escape cover, and water, which provides travel and escape routes as well as sustenance. Deep marshes are most valuable as waterfowl habitat, while shallow marshes serve aquatic mammals. Open water is essential to flocks of migratory waterfowl, while shrub and wooded swamps are of most value to upland wildlife species. Seasonally flooded flats and fresh meadows provide long edges of food and nesting sites for waterfowl and aquatic mammals, as well as some upland game. Bogs are limited in wildlife value, but they offer unique visual quality. Middleborough, however has no naturally occurring bogs.

Both the amount of different wetland types (diversity) as well as the arrangement of these types (interspersion) determines the best habitat suitability. Since most wildlife species require more than one structural type of vegetation, population density and species diversity depend on the presence and length of certain kinds of "edge." An edge is a line of contact between one dominant vegetation type and another. The highest priority would be given to a wetland area with 50% open water and 50% vegetative cover. Within the vegetated areas the plant forms should occur in a variety of sizes and shapes.

Many of the wetlands in Middleborough have gone into succession and are now wooded swamps. This not only makes them difficult to evaluate, but also implies intensive management programs to restore wildlife habitat value.

Two further criteria are applicable to biological productivity. The first criterion is adjacent land use. Agricultural lands, open fields and forests extend food edges and increase the buffer zone around the wetland habitat. Low intensity recreation (hiking, for example) would be a compatible, though not particularly enhancing, adjacent land use. Intensive development, mining or waste disposal would detract from the habitat value.

A second criterion is "connectivity." Wetlands have greater value if they are connected by strips of woodland or by streams which provide safe travel routes for wildlife species. This is particularly true if adjacent wetland classes are different. Biological productivity encompasses many wetland values in addition to wildlife habitat. Education, recreation, scientific research and open space preservation are all related and, though difficult to quantify, are of equal importance to environmental quality.

Size and Uniqueness

At this point, evaluative criteria become more subjective, and final decisions must be made by Conservation Commission members who know the local context. Wetlands in Middleborough range in size from 1 acre or less to several hundred acres. Obviously, the greater the areal extent, the greater the regional value of a wetland because of the increased flood storage capacity, the lessened potential for widespread pollution, the greater life expectancy, the increased range allowed wildlife and the greater the isolated wilderness appeal of such a site. But small wetlands present problems because they are easiest to drain or fill. Each separately does not cause a significant change in conditions, but the combined effect over time can be serious. They should, therefore, be examined

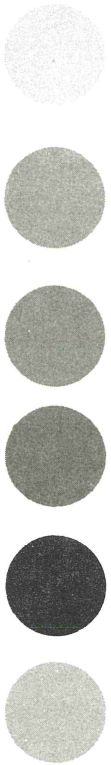
Wetlands (Map 6)

Interpretation: Very poorly drained or wetland areas cover nearly one-third of Middleborough. It will not be possible to purchase or protect all of these as the Town grows. An analysis of the relative significance of wetlands is important to the formation of priorities for open space acquisition.

Use: Combines with Vegetation map to delineate wildlife habitat areas; used with Development Demand map to pinpoint areas where wetlands laws might be violated or where construction costs increased; used with Surface Water and Groundwater Availability maps to estimate hydrologic function.

Sources: Town Zoning Map with inland wetlands delineated by Soil Conservation Service (1971); University of Massachusetts Vegetation 'Map Down', Department of Forestry and Wildlife (1971); U.S.G.S. Base Map.

Legend:



Shallow marsh: seasonal water table 6 inches or less; herbaceous vegetation predominant

Deep marsh: water table depth from 6 inches to 3 feet; herbaceous (non-woody) vegetation predominant

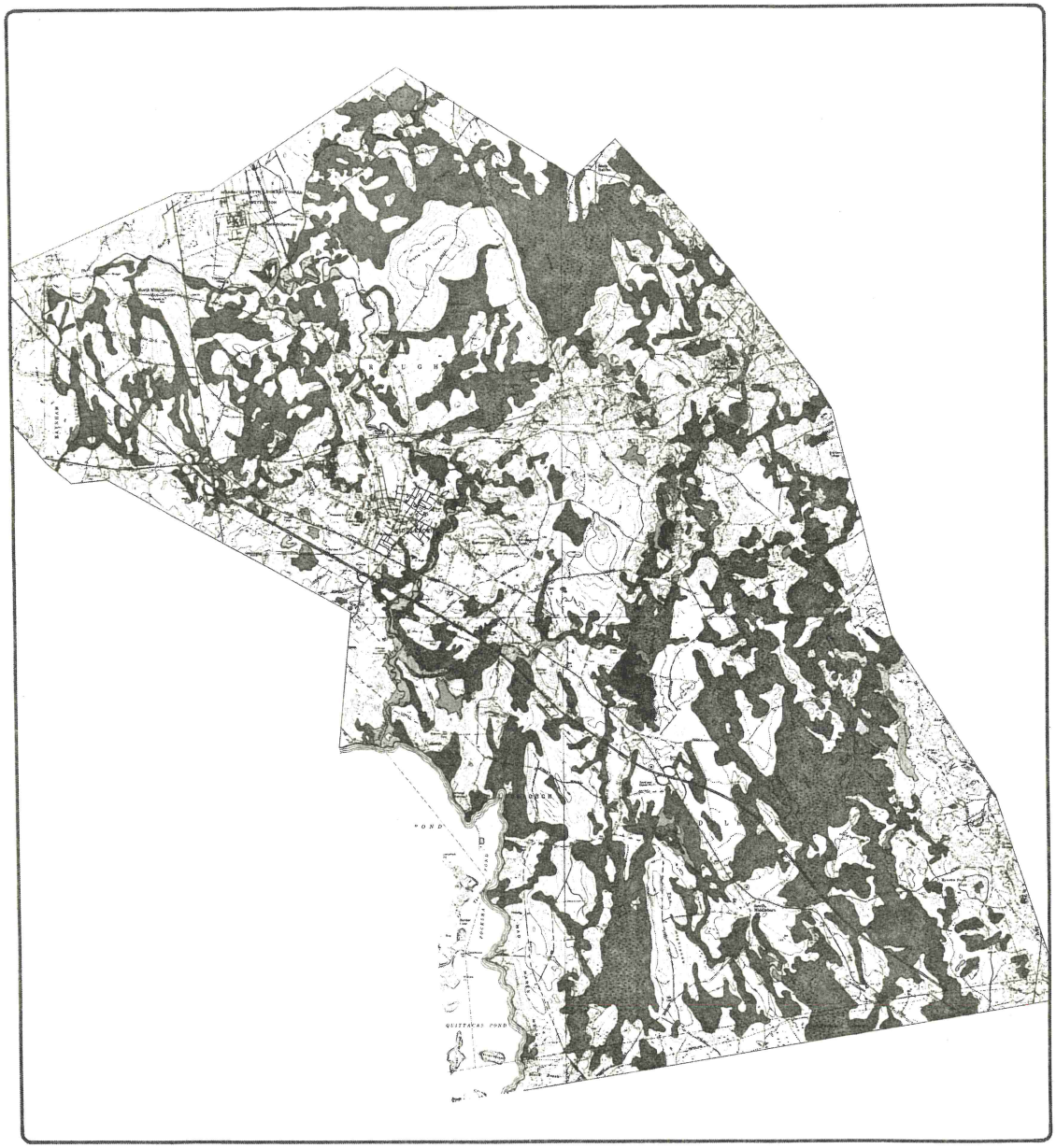
Shrub swamp: seasonal or permanent water table to 12 inches; woody vegetation (shrub)

Wooded swamp: seasonal or permanent water table 12 to 15 inches; woody (tree) vegetation predominant

Open Water: depth from 3 to 10 feet or more; no emergent or woody plants; waterlilies or submergent plants may be present

Seasonally flooded: river floodplains with annual flooding to 12 inches; grasses and sedges predominant

NOTE: Cranberry bogs are not included in the above classification because they are man-made; if abandoned, however, they rapidly become shrub swamps; natural bog and fresh meadow conditions are not mapped because of the infrequency of their occurrence.



Middleborough Open Space Plan

Map 6: Wetlands

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

in the context of previous activity. Smaller wetlands may also deserve special consideration because they are unique in some way.

Wetland uniqueness is another value which is difficult to quantify. The vegetation of marshes and swamps is a unique life form, dependent on specific hydrologic and geologic conditions. In a town such as Middleborough, however, wetland vegetation is so predominant that it wouldn't be considered unique. Criteria for uniqueness have to be more specific. The study team has pinpointed several unique natural wetland areas as part of the Unique Resources Inventory. The selection was based primarily on historical and visual appeal, in addition to natural factors.

Summary

An unaltered resource can be as productive socially and economically as a developed area. The value of wetlands is often intangible and long-range it is not reflected in hard market costs. A full understanding of the costs and benefits of preserving or destroying wetlands is essential, but implementation of preservation policies is made difficult because costs and benefits are not as yet shared equally by all.

Wetland Priorities

On the basis of the criteria mentioned above, the following are recommended as wetland priority areas:

First
- The Nemasket River and adjacent floodplains, swamps and marshes.
- Tispaquin and Woods Ponds and adjacent floodplains and wetlands, including the floodplains of Woods, Shorts and Fall Brooks.
- Black Brook and Devil's Kitchen Swamp.

Second
- The Taunton River and its floodplains and adjacent wetlands.
- The Weweantic River and its floodplains and adjacent wetlands.
- Purchade and Poquoy Brooks, floodplains and associated wetlands.
- Meetinghouse Swamp.
- Great and Little Cedar Swamps.

Third
- Beaverdam Swamp.
- The Rocky Gutter area, including East and West Rocky Gutter Brooks, Rocky Meadow and Double Brooks, floodplains and associated wetlands.

VEGETATION

Approximately 69% of the Town of Middleborough is classified as woodland, according to the 1971 University of Massachusetts Vegetation Survey. Agricultural and open lands comprise about 13% (6,232 acres), and urban lands make up an estimated 10% (4,436 acres). The 6% total given to wetlands (3,190 acres) is misleading, however. Much of what is forested area is actually wooded swampland and, therefore, would more correctly fall into the wetlands classification. Total wetland acreage is more realistically set between 30% and 40%.

Six forest types predominate in Middleborough, and they are closely related to local soil characteristics. The oak forest is the most extensive, and much of it is scrub oak. There are, however, mature stands of scarlet, black and red oak. This vegetative type prefers the drier, sandier soils of the Carver and Gloucester associations. In close association with the oak forest is the pitch pine forest, or the oak and pitch pine mix. This community begins to predominate in southeastern portions of the Town where soils become coarse and dry.

White pine stands or white pine and oak forests are dominant in the northern and western parts of the Town. They prefer the well-drained and excessively well-drained soils of the Hinckley, Essex, Merrimac and Agawam associations. Pine and maple forests and red maple swamps complete the list of forest types. These occur in poorly drained or very poorly drained soils of the Peat-Scarboro-Muck association.

Interspersed with these forest types are many unique vegetative communities. Of particular note are the laurel and holly stands in Devil's Kitchen Swamp, the Atlantic White Cedar found in Great and Little Cedar Swamps, and the holly and hemlock association on the northern shore of Tispaquin Pond.

The distribution of forest types reflects not only the nature of the soils and site conditions, but also the land use history within the Town. The forests of the region have a long history of disturbance by man. Long before the first white settlement, the Indians burned the woodland with slow ground fires to improve the area for wildlife habitat, to increase the supply of berries, and to make foot travel easier. The area has since been the scene of many destructive forest fires. Pitch pine and scrub oak dominate the coarser sandy soils to the southeast partly because of their ability to regenerate after fire damage.

Following settlement by Europeans, and well into the 19th century, woodlands were cut heavily for cordwood, for shipbuilding and to provide charcoal for local ironworks. Much of the woodland thus cleared was then used for hay fields and pasture. After the Civil War and the opening of more fertile farmlands to the west, local cropland was allowed to revert to woodland.

All plant communities expand according to specific patterns. A cleared area with little or no vegetation receives the windblown seeds of sun tolerant herbivorous plants, such as grasses, aster

Vegetation (Map 7)

Interpretation: Approximately 69% of the Town is forested; this is a greater percentage of forest cover than during the colonial period. The vegetative pattern is a primary determinant of the rural character and the visual appeal of Middleborough's landscape. Open areas indicate lands which are potentially vulnerable to visual changes associated with extensive development.

Use: Combines with Wetlands map to indicate high quality wildlife habitat areas; combines with Development Demand to determine whether new housing or industry or other development is locating in a visually absorptive area.

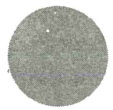
Sources: Aerial photographic verification (600'/inch) of University of Massachusetts Vegetation 'Map Down' for the state, Department of Forestry and Wildlife (1971).

Legend:

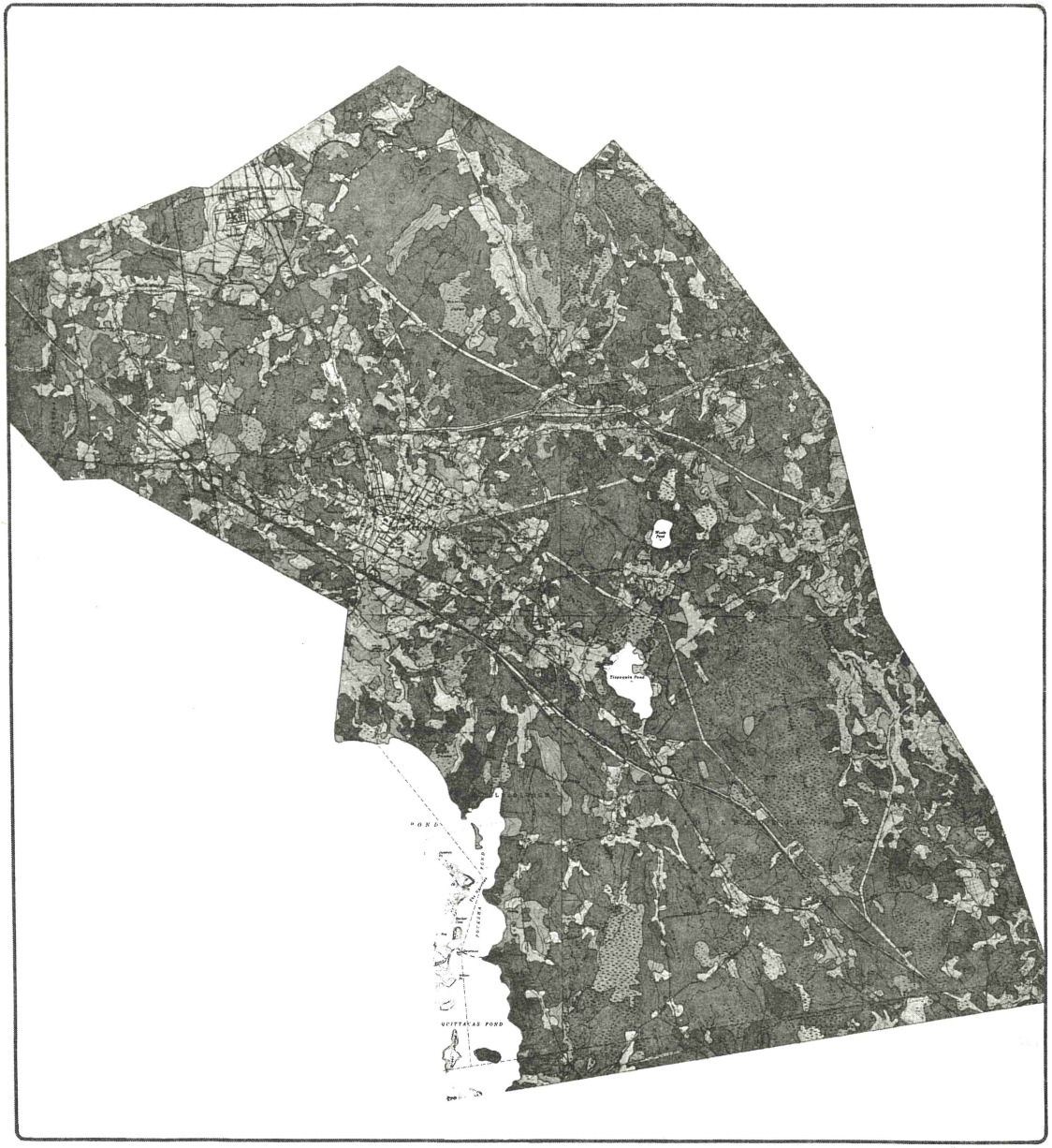
Agricultural and open lands: pasture, tilled fields, cranberry bogs, abandoned fields, power line and transportation corridors, low-growth wetland areas (deep and shallow marsh) and urban, non-forested areas

Deciduous woodland and shrubs; oak and maple predominant

Coniferous forest or shrub cover; white pine, pitch pine and hemlock predominant



Mixed coniferous and deciduous woodlands; includes wooded and shrub swamps; oak, white pine, pitch pine and maple



Middleborough Open Space Plan

Map 7: Vegetation

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

and goldenrod. As these die and decompose, they change the organic nature of the soil and a wider variety of vegetation begins to appear. Most typical are small shrubs like blueberry and juniper. These in turn die and decompose, again changing the organic composition of the soil. Volunteer seedlings of larger, shade tolerant woody plants then appear, cherry and scrub oak, for example. Later still appear pine, oak and maple species. The sequence continues from cultivated field to abandoned field to young forest to the equilibrium of a mature forest, until some natural or man-made event brings it to an end. The process is known as "vegetative succession," and it is common to woodland, wetland and arid plant communities alike. It is a concept important to the understanding of the landscape as a dynamic, rather than a static, natural system.

Definite trends of succession are now occurring on abandoned farmland in Middleborough. On finer textured soils, white pine colonizes first, but it is then taken over by scarlet and black oak, and other hardwoods. On coarser soils, however, pine meets less competition from hardwoods, although they do invade as understory trees. In general, upland areas of till are the best forest sites, while stratified outwash and lakebed deposits support poorer forests.

One of the most significant reasons for studying the vegetation of the area is because of the visual and spatial character it provides within the Town. For the most part, Middleborough is still a visually pleasant place. When seen from its roads and highways, it presents a traditional New England landscape of open fields backed by forests. This rural quality is of great value to local residents, but it is beginning to be undermined in places by powerlines, mining operations, and strip development.

A vegetative survey is helpful in determining which areas are most vulnerable to visual change. These include water/land edges, open wetlands, exposed hilltops, unique vegetative stands and agricultural lands. These are areas which contribute most significantly to the Town's rural image and are those which, if substantially changed, would change the nature of the local landscape. Areas which cannot screen development or mining operations by either vegetation or topography cannot "absorb" these land uses. Power line rights of way, particularly where they cross roadways, are yet another source of visual disturbance. Specific examples of unique and vulnerable visual areas are pinpointed on the Unique Resources Map.

Potential wildlife habitat can also be determined from the Vegetation Map, particularly in combination with the Wetlands Map. Diversity, or the abundance of plant species within an area, is the key concept in this instance. The greater the biological richness of an area, the greater its value for a large number of wildlife species. An area which has equal proportions of mixed coniferous and deciduous woodland, open fields or agricultural areas, and wetlands (especially deep and shallow marsh) abutting open water would be considered prime potential wildlife habitat.

WILDLIFE

Middleborough is part of a region in southeastern Massachusetts where development is applying increasing pressure on wildlife habitat. Roads and subdivisions continue to encroach on forests and wetlands. Domestic animals, particluarly dogs, present an additional threat; they run power line easements and thereby gain access to formerly isolated habitat areas. Only those species which can adapt to the suburban environment will remain.

Additionally, much of the area has undergone vegetative succession and is now in mature woodland which lessens its habitat value. An intensive management program would help to realize Middleborough's potential, perhaps regionally, as a major wildlife area.

As a relatively open town with a mixture of wood and farm lands, Middleborough once enjoyed a rich and diverse wildlife population. White-tailed deer are the only big game animals to be found in the Town, but their numbers have decreased considerably. Small upland game species are still abundant. Among them are ring-necked pheasants, quail, ruffed grouse, wood cocks, cottontail rabbits, varying hares, opossum, raccoon, grey squirrel and fox species. Pheasant and quail are released annually in the Town by the Massachusetts Department of Fish and Game. Their populations are kept in check, however, by hunters and predatory animals.

Wetlands and cranberry bog reservoirs support black and wood ducks. Due to the Town's location on the Atlantic flyway, a large number of migratory waterfowl pass through annually, using the many swamps and marshes as resting and feeding areas. Muskrat, otter and mink also inhabit the lowland areas around swamps.

Lakes, streams and ponds support many game fish, including brook, brown and rainbow trout, large mouth bass, and pickerel. The Nemasket River is the site of an annual herring run, the return of the herring to their birthplace for spawning. The fish travel upstream to Assawompset Pond, and the Conservation Commission has built several fish ladders to make the journey possible through the shallower reaches of the river.

The occurrence and abundance of wildlife in the Middleborough area is influenced by land use, type and diversity of plant cover, topography and the availability of fresh water. In the irregular moraine hills and pitted outwash plains along the Weweantic River, the predominant vegetative cover is scrub oak and pitch pine. The dense scrub growth provides escape cover for deer as well as a food supply of acorns, twigs and buds. Winter snows are seldom deep enough to prevent foraging. Cover, food and nesting sites are also available for grouse in areas adjacent to kettle holes. The food supply here includes blueberries, blackberries, cranberries and the seeds of locust, catbrier and sumac. Bushy undergrowth and laurel thickets in wet areas provide twigs and bark for rabbits and hares.

In the northern and western portions of the Town, in the Taunton and Nemasket River watersheds, are gently sloping outwash plains, swamps and low hills and ridges. White pine and hardwood forests are

predominant in the uplands, and red maple swamps occupy wetland areas. In these locations deer and smaller game find food and cover in swamps and brushy woodlands. Hayfields and pastures provide grazing areas in the spring and fall. Grouse and quail prefer the seed and berry producing shrubs in the brushy borders between woods and fields. Black locust thickets provide escape cover and nesting sites. The cultivated fields are preferred by pheasants which feed on corn and grain crops. Many owls and hawks roost in the wooded areas and hunt in the abandoned fields along the Taunton River. Muskrat, mink, otter and an occasional beaver are found in marsh areas; the waterfowl population is greatest along streams, in dammed areas and in flooded wooded swamps where dead trees are preferred nesting sites.

Clearly there is a wide variety of habitat requirements for a local wildlife population, and some criteria are essential to determine which upland and wetland sites are best. The following criteria can be used in delineating prime wildlife areas.

Habitat Diversity

The abundance and arrangement of vegetative types is significant to the richness of a wildlife population since most species depend upon more than one type of vegetation for their existence. Fresh water is equally critical; it works in combination with a variety of vegetation types to create many "edges" or lines of contact between dominant habitat components. It is these interfaces which are the most valuable in providing ecological niches. Interestingly, power line cuts, and other areas which have been cleared and are in the process of growing back, have considerable wildlife value. Such disturbed areas increase the local edge conditions.

Size

The home range of wildlife species includes all areas needed for feeding, rest and cover. The greater the size of a habitat area, the greater would be the insulation and longevity of the wildlife population. Highways or railroads which transect large, open areas cut across and thereby diminish the home range of local wildlife.

Size is sometines dependent on vegetative diversity. For example, a small area rich in habitat types could support the same or greater population as a larger, less diverse area.

Adjacent Land Use

Surrounding land uses enhance the value of wildlife habitat by increasing the buffer and edge conditions. Undeveloped or agricultural lands which surround upland habitats, and forests and cropland which surround wetlands are most ideal. The greater the distance from urbanized areas or intensive land uses, the greater is the habitat value for wildlife.

Linkages

Wildlife species need safe travel routes between home range areas. Therefore, upland or wetland sites which are situated along streams or connected by strips of woodland are most significant.

Management

Some habitat areas are valuable in their existing condition, while many need some type of management to be of highest value. Management implies some degree of human interference, such as clearing, planting or water retention, and therefore involves monetary expenditures.

Middleborough is one of the few remaining towns in southeastern New England which have large expanses of land capable of supporting a rich wildlife population. If these lands are acquired and managed now, the Town and the region could derive enjoyment and educational benefits from this significant natural resource.

A listing of local wildlife species is included in the Appendix to this report.

Wildlife (Map 8)

Interpretation: The Wildlife map locates those areas of known and potential wildlife habitat containing adequate supplies of food, water and escape and nesting cover. Human land use activity could easily reduce the probability that a particular species will survive in any location. Habitat areas serve to further define valuable open areas within the Town. Primary habitat areas should be given highest priority.

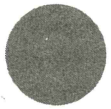
Use: Combines with Development Demand map to predict, and perhaps prevent, habitat disruption caused by noise, clear cutting and visual encroachment of new development activity.

Sources: U.S. Fish and Wildlife Survey (1966); Plymouth County Soil Survey (1969); Plymouth Conservation District Natural Resources Study (1970); Richard Millette, Arnold Thomas and Dorothy Briggs, residents of Middleborough.

Legend:

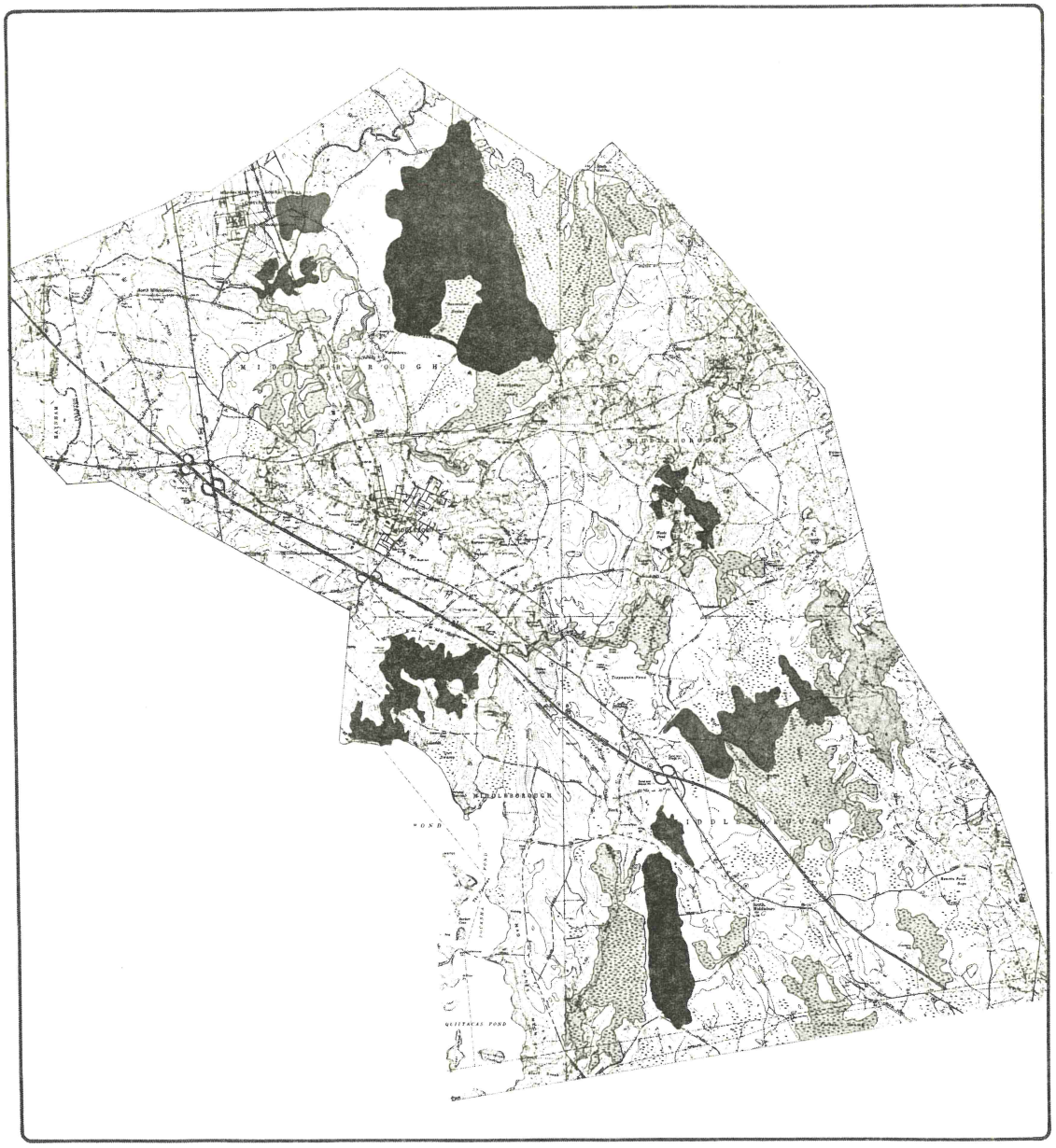
Primary wetland habitat; suitable and productive in its present state

Secondary wetland habitat; areas which could become primary habitat with some form of management (flooding, cutting)



Primary upland game habitat; suitable and productive in its present state; proximity to water and wetland areas necessary

Secondary habitat locations for upland game; needs management to increase value



Middleborough Open Space Plan

Map 8: Wildlife

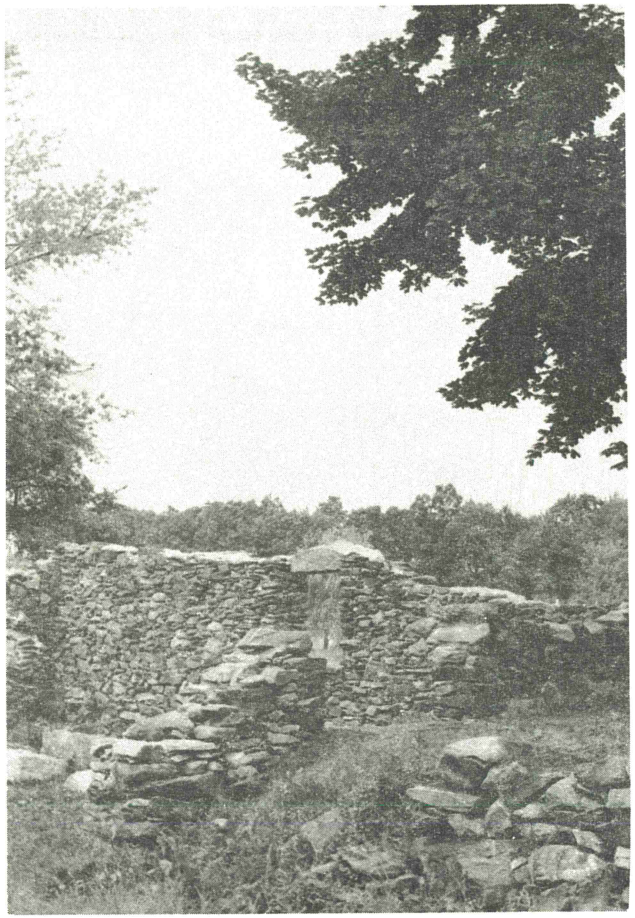
10 square acres

1 square mile

0 1 2 3 4

scale in miles

north



Oliver Mill Park

UNIQUE RESOURCES

There are, within the Town of Middleborough, areas which have distinct appeal for their particular visual quality or historical significance, as well as natural areas which are important in the study of the environment. These have been inventoried and mapped as Unique Resources. Although this resource category is somewhat subjective, its intangible values are necessary to the determination of attractive conservation and recreation lands. When used in combination with other resource categories, Unique Resources can serve to add appeal to potential open space sites, since an increased number of functions increases the value of a given parcel. Such a multi-purpose approach is necessary to stretch conservation budgets.

Visual resources include places which afford regional views, areas which are sensitive to visual change because of the low absorptive capacity of vegetation and topography, and places which characterize the rural appeal of Middleborough, particularly woodland/agricultural edges and water/woodland areas.

Because of its proximity to the original Pilgrim colony in Plymouth, Middleborough has a rich historical heritage: Indian encampments, homes of Ton Thumb of Barnum fame, and of the Eddy family; traces of the Colonial bog iron ore industry; and an abandoned stage coach route. The newly established Middleborough Historical Commission has expressed interest in cooperative efforts with the Conservation Commission.

Vegetation and topography provide many unique natural study areas. Wetland vegetation is abundant; particularly noteworthy are the stands of Eastern White Cedar (Chamaecyparis thyoides), American Holly (Ilex opaca), and laurel and swamp azalea (Kalmia and Rhododendron species). There are several interesting geologic formations, especially those which relate to past glaciation of the Middleborough area. Eskers and kames are predominant and Barden Hill is a particularly good example of the latter. Its peak offers one of the few panoramic views of the surrounding landscape. Unfortunately many similar formations are threatened by sand and gravel mining operations. Bedrock outcroppings provide additional points of interest and variety. One such exposure, on East Grove Street south of Middleborough center, displays glacial striations or grooves cut by massive ice sheets about 10,000 years ago.

Unique resources are listed by number in the Appendix to this report.

Unique Resources (Map 9)

Interpretation: The Unique Resources map pinpoints areas of special historic, visual or natural significance, both regionally and locally.

Use: Introduces important subjective values to the process of selecting priority open space lands; locates areas with environmental education potential; adds a 'multipurpose' value to planned open space areas.

Sources: Mr. Richard Millette, Conservation Commission member; Middleborough Historical Commission; Surficial Geology map; Open Space Questionnaire; Field checking.

Legend:

Historic Building

Historic Place

Historic Trail

Unique Visual Element or Zone

Unique Natural Feature or Zone

Middleborough Open Space Plan

Map 9: Unique Resources

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

EXISTING OPEN SPACE

The Town of Middleborough does have some areas which are now set aside for conservation and recreation purposes. These are mapped as Existing Open Space. For the purposes of this study, it was decided that cemeteries and private landholdings of various clubs and camps would not be considered as Existing Open Space, because of their relative inaccessibility to Town residents. The New Bedford Watershed land is included because it protects a regional resource and is relatively unchangeable in status. Its lands, however, are not available to Middleborough residents for any type of activity, as mentioned in the Hydrology section of the Resource Inventory.

Existing Open Space ownership falls into three land categories: Town Owned, Conservation Commission Owned and State Owned lands. These are listed by type, size and function in the Appendix to this report.

The significance of Existing Open Spaces is primarily that they are already protected areas. They thereby provide a basic framework from which to build a larger open space network. When these areas are mapped, they begin to form a pattern which suggests opportunities to link existing with proposed open space areas. It is felt that control and maintenance of contiguous parcels of land are more feasible than of isolated and unconnected parcels. In addition, a contiguous open space system creates the illusion of a much larger expanse of land, particularly for linear activities such as bicycling and hiking.

When used in comparison with the Development Demand Map, it is easy to pinpoint areas of the Town which are deficient in open space. These areas should be given some priority for land acquisition. It can also be seen by such a comparison that, while Middleborough has many acres of open space per capita, much of this land is not accessible from major population centers.

Urban Open Space

It is useful at this point to look at Existing Open Space areas in the Town center, (Figure 11). Of the four major open space areas, only one, the Pierce Playground, is being used to its maximum potential. The West Side Playground and the adjacent Nevertouch Pond, and the Burkland and Mayflower Schools are in need of funding to increase their use for intensive recreation. As indicated by the Preference Survey, residents of the Town center see the need for additional tennis and basketball courts, especially lighted facilities. Another shortcoming of the present urban open space system is the lack of neighborhood play areas for smaller children. The Town might want to consider small, tax delinquent parcels for this, rather than residential, use.

Future plans for downtown open spaces will want to consider a system of linkages: malls, alley-ways, and the like, which will provide safe travel routes between larger parks and recreational facilities. The present pattern even suggests potential connections to a larger Town open space network. Oliver Mill Park, for example, is within a reasonable hiking or biking distance from the Town center,

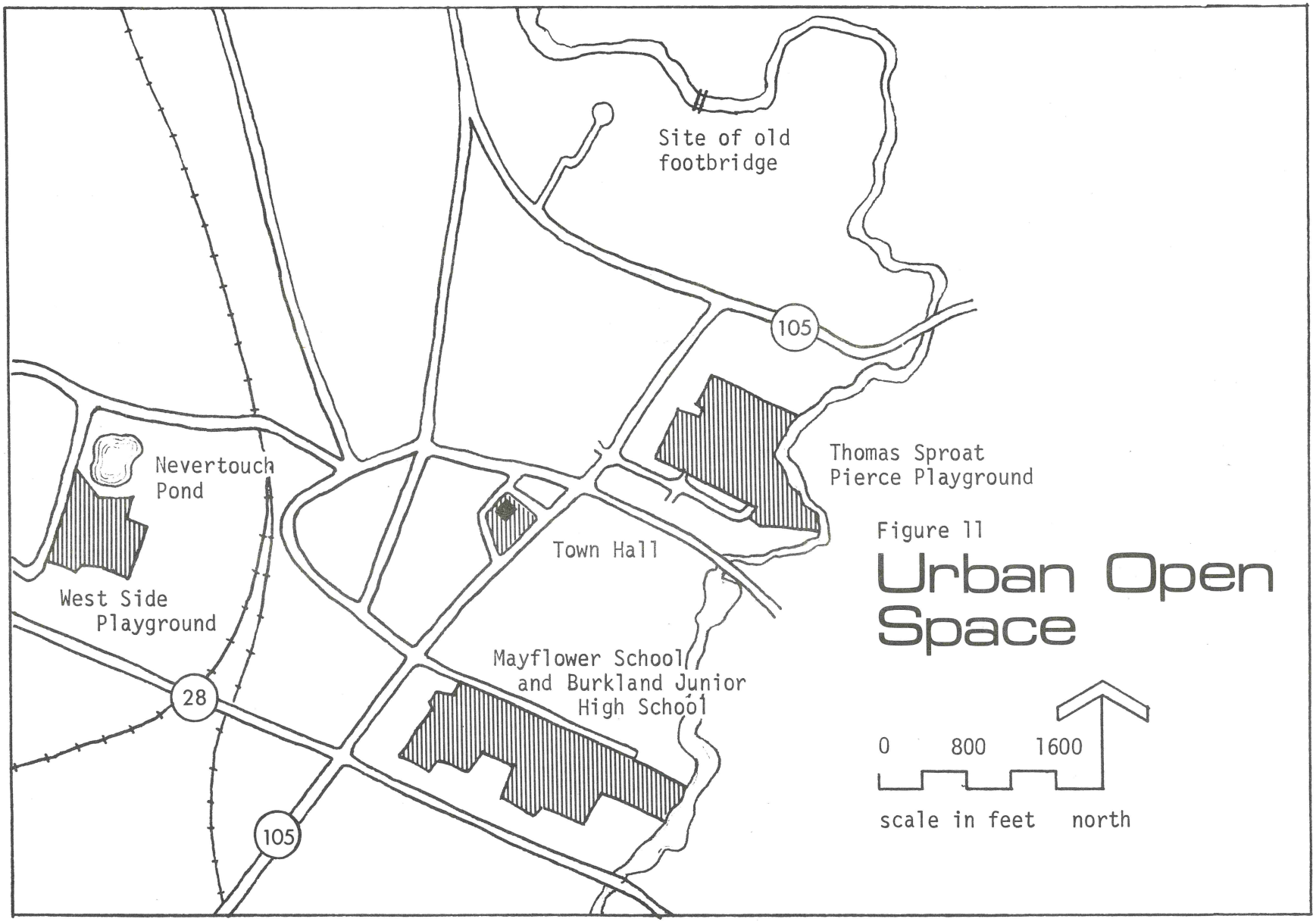


Figure 11

Urban Open Space

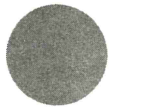
Existing Open Space (Map 10)

Interpretation: Within the Town, there are certain areas already set aside for conservation and recreation purposes. These are designated as Existing Open Space, and they form the basis for future open space planning and acquisition.

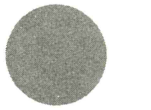
Use: Combines with Natural Resource Composite to determine degree of protection already afforded some resources; combines with Development Demand map to pinpoint areas deficient in conservation or recreation lands; used with proposed Plan for Open Space to determine potential connections between existing conservation and recreation areas or potential sites for expansion.

Sources: Town Master Plan (1971); Assessors Maps; Conservation Members; Plymouth Conservation District Natural Resource Inventory (1970).

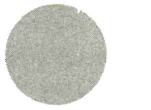
Legend:



Town Owned Open Space

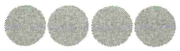


Conservation Areas



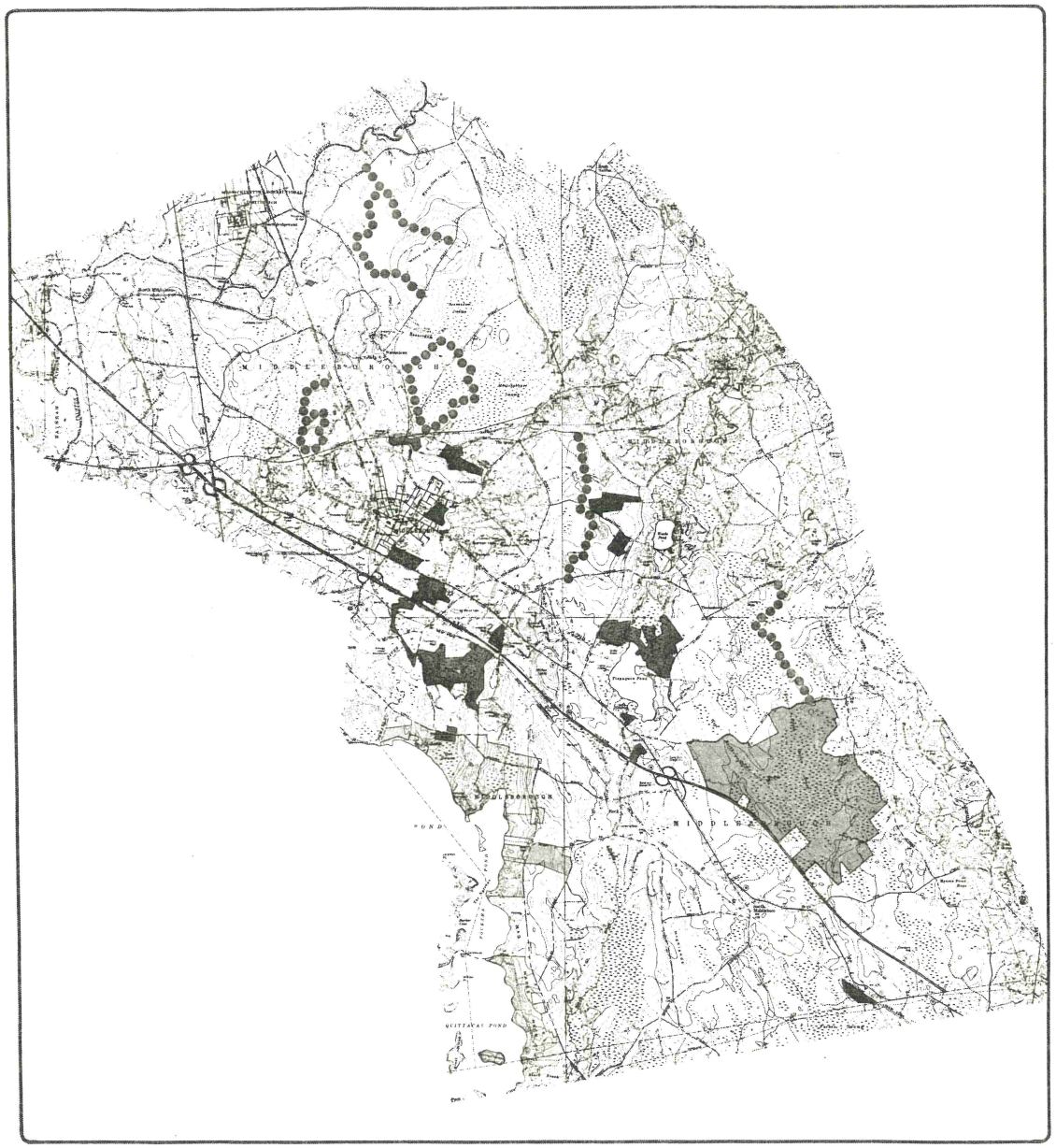
State Owned Open Space Land

New Bedford Watershed



Existing Trails

NOTE: Cemeteries and private landholdings are not included in the above classification due to their relative inaccessibility; all existing open space areas are described in detail in the Appendix Section of this report.



Middleborough Open Space Plan

Map 10: Existing Open Space

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

provided that a suitable trail system was available. The Pierce Playground is particularly well situated on the Nemasket River; it could be the starting point for trails leading up or downstream, or across to the Barden Hill area. Such a trail was recently proposed by the Town Water Department for its own maintenance purposes. A cooperative effort between the department and the Conservation Commission and the Parks and Recreation Department could result in a multi-purpose trailway.

The north side of Town, which is largely, residential, could provide another point of connection between the urban area and the Town Open Space System. This would be particularly as a result of the restoration of the old foot bridge across the Nemasket, just south of Valley Road.

As mentioned in Section 6, funds from the Department of Housing and Urban Development might be appropriately applied to these more urban needs.[2]

[2]Unfortunately, since the initial writing of this study, HUD funding has become unavailable.

Lion's Neck

DEVELOPMENT DEMAND

This category includes those lands which are classified as urban commercial, urban industrial, commercial residential and residential and thereby indicates the general development pattern in Middleborough. Areas of potential development are also delineated as generalized zones. These are areas in which development has not yet occurred but which have filed as a subdivision with the Town. Future growth trends can be inferred from these zones.

The Development Demand Map illustrates where and in what pattern the need for open space will be the greatest. Ideally, areas of greater need will be given some priority for open space acquisition. In addition, the map may serve to pinpoint areas of potentially severe conflict between development and natural resource protection.

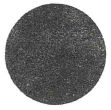
Development Demand (Map 11)

Interpretation: The Development Demand map illustrates the potential growth pattern of Middleborough. Demand can also be indicative of general real estate values. Areas of critical environmental concern located within or near rapidly developing areas will need strong and immediate protection strategies such as zoning, easement acquisition or purchase.

Use: Combines with Existing Open Space map to pinpoint current and predict future open space deficiencies; used with Natural Resource Composite to locate sensitive resource areas which are under the greatest pressure for development.

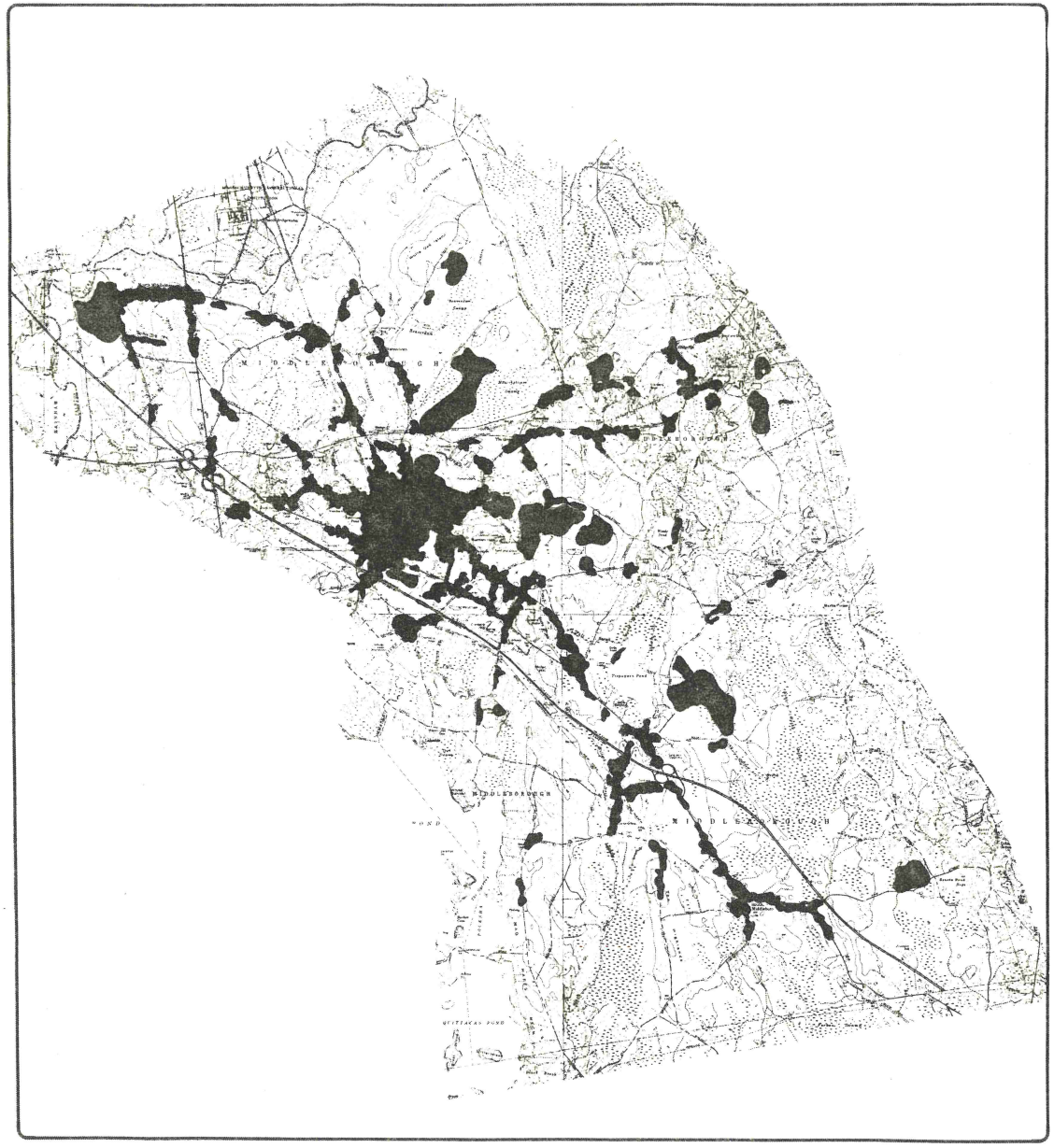
Sources: Aerial photographic verification (600'/inch) of University of Massachusetts Vegetation 'Map Down', Department of Forestry and Wildlife (1971); Subdivision Permits File, Middleborough Conservation Commission.

Legend:



Urbanized areas: includes residential, commercial, industrial, extractive and waste operations

Proposed development zones: general areas with subdivision permits or applications on file with Town Planning Board.



Middleborough Open Space Plan

Map 11: Development Demand

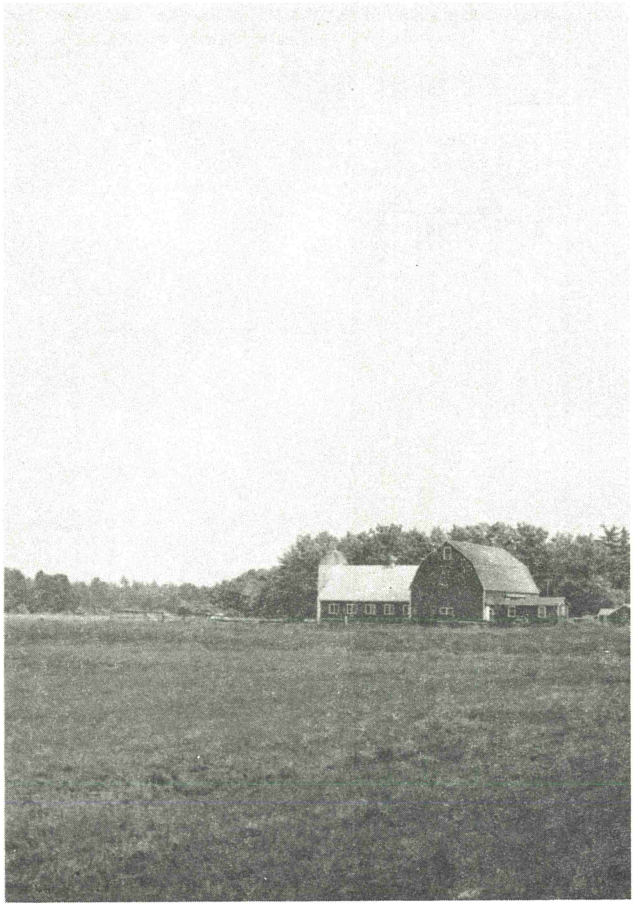
10 square acres

1 square mile

0 1 2 3 4

scale in miles

north



River Street and Thompson Road

NATURAL RESOURCE COMPOSITE: POTENTIAL OPEN SPACE AREAS

To achieve the Natural Resource Composite, the eight vulnerable resource categories were synthesized into three critical environmental resource areas: (1) Surficial Geology, Soil Type and Groundwater Availability Maps defined areas which insure the quality and quantity of groundwater resources; (2) Surficial Hydrology and Floodplains, Significant Wetlands and Soil Erosion Potential were combined to delineate areas which insure the quality and quantity of surface waters; and (3) Vegetation and Wetlands maps were combined to indicate wildlife vulnerability. All preceding inventory maps were used, and the most significant zones from each figured in the final synthesis. In addition, Unique Resources remained as a fourth critical environmental type.

Each of these four categories was then delineated graphically on a transparent medium. Hachure marks were used in order to distinguish each category in the final overlay. When all layers are superimposed, the additive effect of the critical environmental resource areas can be demonstrated. The following matrix illustrates the possible graphic combinations and their significance, (Figure 12). In this way, resource variables which have equal weight can, in their cumulative occurrence, become more significant. Areas which appear to have the darkest tones or the most complex pattern incorporate the greatest number of resource potentials, and are therefore most sensitive. It is these areas that delineate the significant natural resources in the Town.

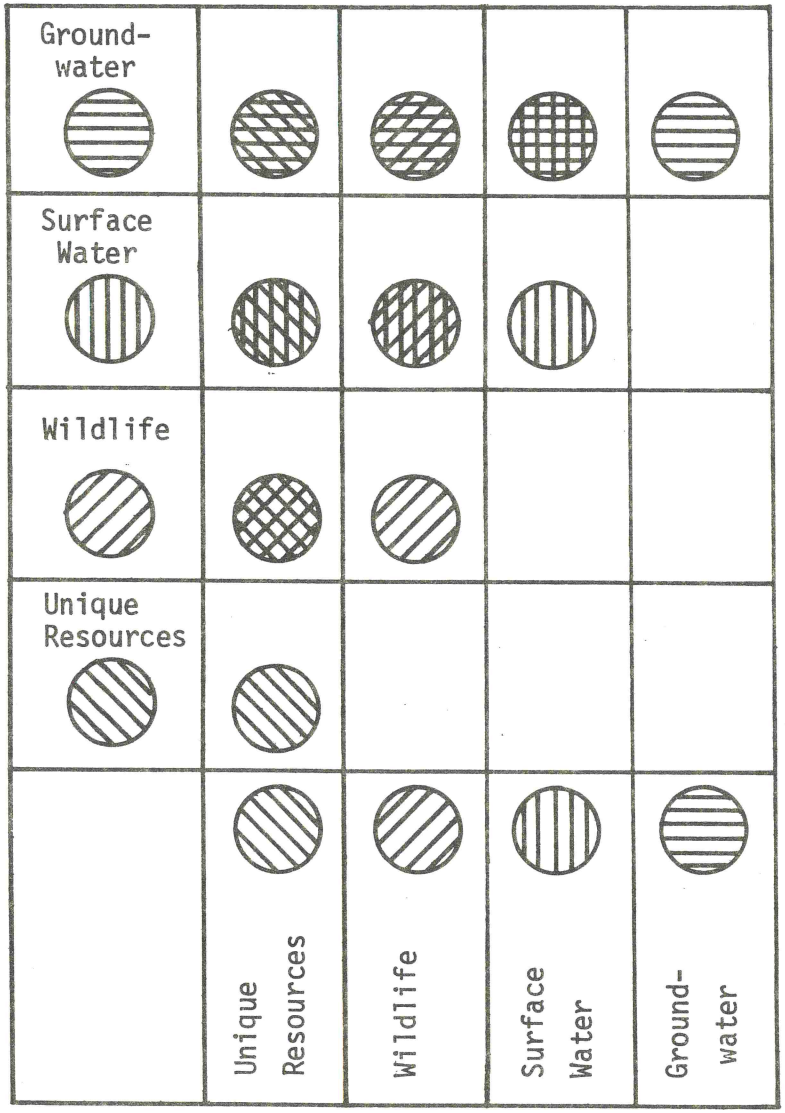


Figure 12: Possible two-level graphic combinations on the Natural Resource Composite Map; three and four level combinations occur in some instances.

Resource Composite (Map 12)

Interpretation: The Natural Resource Composite locates the most environmentally sensitive 'zones' within the Town. All resource categories were combined to illustrate varying degrees of vulnerability: the more complex the pattern, the more complex--and thereby more vulnerable--is the resource base. These 'zones' provide a basis for ecologically oriented land use decisions.

Use: Existing Open Space and urban areas from the Development Demand map were subtracted from the Natural Resource Composite to arrive at the Priority Plan for Open Space.

Sources: Resource Inventory Maps

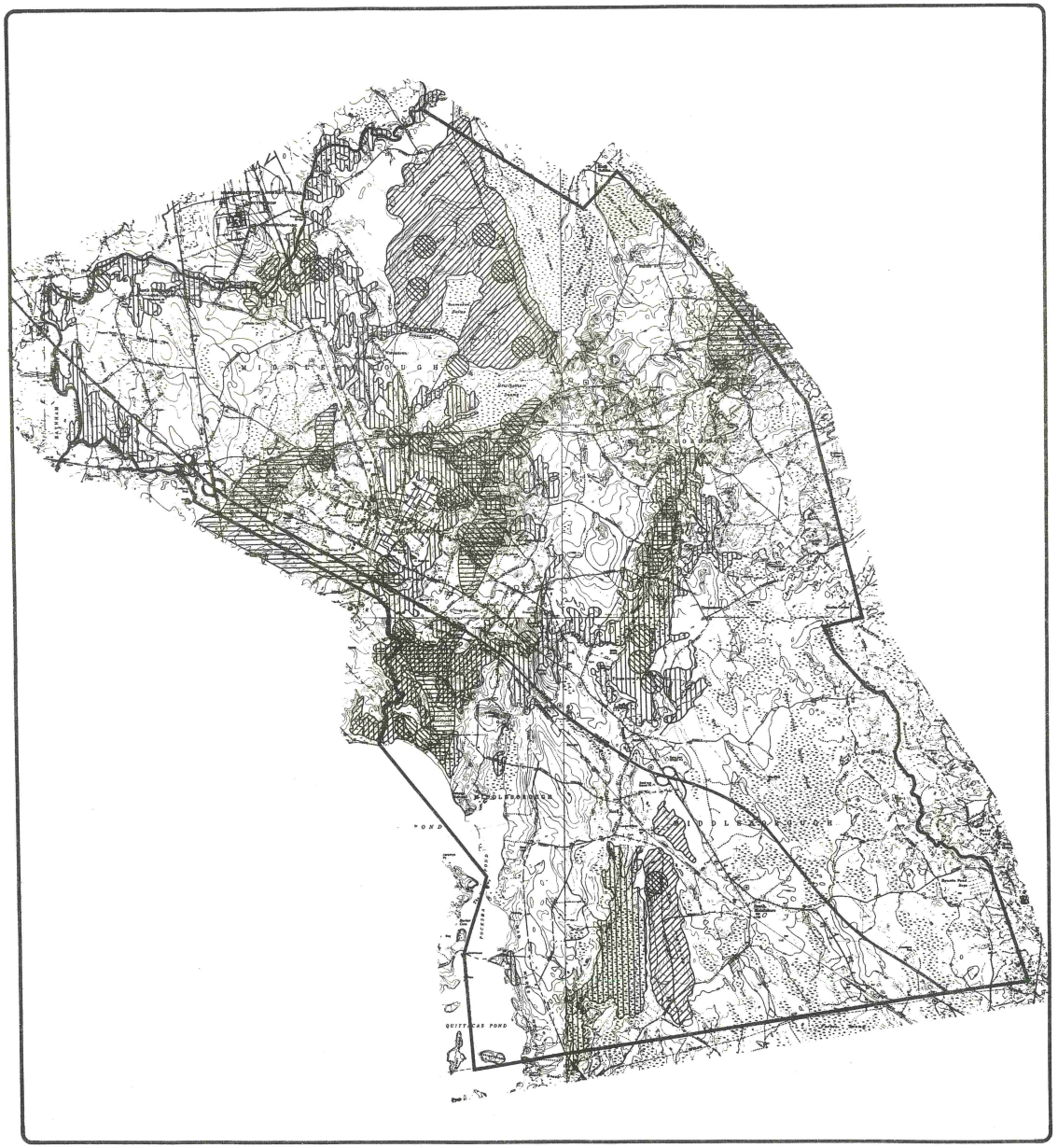
Legend:

Vulnerability to Surface Water Pollution: Soil Erosion Potential, Significant Wetlands, Surficial Hydrology and Floodplains.

Vulnerability to Groundwater Pollution: Surficial Geology, Soil Type, Groundwater Availability

Wildlife Vulnerability: Vegetation Type, Wetlands, Wildlife Habitat

Unique Resources: Historic, Natural and Visual



Middleborough Open Space Plan

Map 12: Resource Composite

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

3
TOWN GOALS

MIDDLEBOROUGH'S OPEN SPACE GOALS

Recreational Preferences

The Conservation Commission, with suggestions from the Regional Field Service team, designed and distributed a survey in an attempt to index the general goals and preferences of the Townspeople in regard to conservation and recreation. The survey was distributed to and returned by more than 500 people, including senior and junior high school students, town officials, private hunt club members, the elderly, and citizens attending Town Meetings. A copy of the questionnaire can be found in the Appendix to this report. In addition, six public meetings were held. Three of these were open to members of other Town agencies (Planning Board, Historical Commission, etc.) and three were held in the outlying neighborhoods of the Town: North, South and East Middleborough. Comments of the Townspeople were noted and are included in the discussion below. These meetings were particularly helpful in determining specific local needs and in learning local attitudes to proposed implementation strategies. Mapping, which was done by several individuals, is included as part of the Unique Resources inventory.

Activities

Although items in the activities category could not be scored solely against one another for reasons of seasonality, availability and cost to the individual, the activity choices which emerge are felt to be significant and reliable indices of local preferences and areas of demand, both current and future. Driving for pleasure is the most popular leisure activity of Middleborough residents of all ages. This is not surprising in view of the areal extent of the Town (approximately 70 square miles). It does, however, place much emphasis on the visual quality of the town's roadsides. Route 28, which emerged as the most frequently traveled route for business and pleasure, is the only road zoned for general use, and strip development is virtually uncontrolled. Many other roads in the Town are quite scenic, and historic designation is planned and recommended for at least two of them: Plymouth Street and Marion Road.

Pond swimming is preferred to pool swimming, except at the junior and senior high school level. Generally, the more adult the range the greater the preference for pond swimming, but pool swimming is a favorite for the elderly.

This suggests a dual development of swimming facilities. The pool at the Thomas Sproat Pierce Playground is used extensively by young and old citizens from all over Town. There is a need for additional high intensity recreation facilities in other than the center of Town. Access to pond swimming presents an even greater problem. Since there is no access to the Great Ponds, Tispaquin Pond becomes the only alternative. As mentioned above, Tispaquin needs considerable development before it could provide beach facilities.

Other high intensity sports which received much attention were tennis and basketball. In many

cases the request specifically stated the need for lighted facilities. Perhaps swimming, tennis and basketball could be accommodated in a combined facility elsewhere in the Town and thereby alleviate the crowded conditions at the Pierce Playground.

Team sports and playfield usage were particularly important to the outlying neighborhoods of Middleborough: North, East and South. In Middleborough center, the West Side School playground facilities could be improved to extend present usage.

Bicycling was mentioned frequently throughout the survey by all age groups, but especially the young and the elderly. There was significant response to warrant serious consideration of bicycle paths and a bicycle trail system through the Town. Certainly the gentle topography of the Town lends itself to such endeavor. In a regional context, and in light of the upcoming Bicentennial, an historical bicycle tour has been recommended. Such a bikeway would provide a connection from the urban center to the open space system.

Canoeing, hiking and picnicking received significant attention. Again the need for linear forms of recreation is apparent. Interestingly, more people prefer to visit historic sites than nature study areas; there is however, a definite interest in birdwatching.

Bowling, ice skating and golf, although they are generally cost dependent, were next in popularity. High school students and the elderly particularly enjoyed bowling. The demand for a better ice skating facility at the Pierce Playground is evident, and the Parks and Recreation Commission of Middleborough has been considering this need.

Fishing is about three times more popular than hunting, although there are many hunting clubs in Town. People also expressed interest in doing more fishing.

Horseback riding, although it has a low demand frequency, is another activity which has strong localized demands, and future potential.

Snowmobiling brought a strong request from adults for complete restriction of this activity, while younger people, who had never used snowmobiles, wanted to try. Cross-country skiing and snowshoeing had relatively low frequency, probably due to the limited duration of snow in the area.

The neighborhood meetings enabled the study team to pinpoint specific areas of concern in North, South and East Middleborough; they turned out to be surprisingly similar.

North Middleborough residents expressed the need for intensive recreation areas for tennis, basketball and ball playing. This was felt to be of special importance for the young people in this area. The designation of this part of Middleborough as an historic district was of equal concern.

In South Middleborough, because of its distance from the center of Town and the fact that children have to be bussed in order to participate

in recreational activity, a local playground and playfield facility would have top priority. At this meeting, residents expressed dismay at the apparent lack of concern for environmental issues, and suggested that environmental education must be handled cautiously.

East Middleborough residents were particularly discouraged by the destruction of the Great Cedar Swamp, and expressed interest in stronger control of wetlands. As a predominantly agricultural community, they were interested in tax advantages to owners of abandoned farm lands. They too were in favor of historic district zoning in their part of Middleborough as well as the possibility of an East Middleborough community park.

Places

Oliver Mill Park rated number one as the place to visit. It was followed closely by the Pierce Playground, Tispaquin Pond, the Town Forest, Weston Conservation Property and Rocky Gutter Wildlife Refuge. Interestingly, many respondents mentioned that they were unaware of the existence or location of some of these existing open space areas. This suggests a strong need for the cooperative listing and mapping of these areas in brochure form, for local people and visitors alike.

Resource Problems and Priorities

The problem of the Town tax rate was specifically included because it is the issue which most often works against open space acquisition. It has emerged, as expected, as the major concern of Town residents. Open space is viewed as land taken from tax rolls; bond floating for conservation and recreation is untried, as is the exclusive use of revenue sharing funds, which would otherwise indirectly lower the tax rate. A major task of the Conservation Commission will be to convince Townspeople of the value of open space preservation.

In order of priority from the most to least critical, the natural resource problems which did emerge were: (1) pollution of the Nemasket River and other surface waters; (2) destruction of the rural and historic character of the Town; (3) pollution of the groundwater supply; (4) loss of wildlife habitat; (5) uncontrolled development of open areas and (6) filling of wetlands.

When asked to describe Middleborough's most significant resource the following were mentioned most often: (1) the Nemasket River; (2) the rural quality of Middleborough; (3) Oliver Mill Park; (4) the ground water supply; (5) cranberry bog terrain; (6) the Great Ponds; (7) cedar swamps and (8) woodlands.

The Regional Field Service team believes that their recommendations for open space were made better by citizen participation. The future success of the Open Space Plan depends on the continued interest and involvement of all the people who have already been so helpful.

4
PRIORITY PLAN FOR OPEN SPACE

THE PLAN FOR OPEN SPACE

The process of designing an Open Space System for the Town of Middleborough has consisted of several parts. First was the definition of conservation and recreation objectives by the Conservation Commission and the Regional Field Service team. Then came the organization and compilation of a Resource Data Base which was established by the Resource Inventory. And, finally, the most significant areas from each of the resource maps were combined to form the Natural Resource Composite of potential open space areas.

In the final design of the Priority Plan for Open Space, the Natural Resource Composite (potential open space areas) was reshaped by delineating the currently developed areas of Town (from Development Demand Map) and the areas now set aside as conservation or recreation lands (from the Existing Open Space Map). The areas which remained are those which are available for acquisition. These were then divided into first, second and third priority areas for acquisition by the Field Service team, on the basis of Town goals which were surveyed early in the study (Section 3). The highest priority went to areas of critical environmental concern which also incorporated a combination of goals stated by the residents of Middleborough. The overall strategy of the Conservation Commission and the study team was not to purchase the most of the cheapest land, but to safeguard, through purchase and protection, lands which could serve many functions.

In addition to the above considerations, the Commission and the study team felt that certain "open space linkages" should be incorporated as part of the plan to integrate open space parcels into a contiguous network. They are not always areas of critical environmental concern, but their location between such areas makes them significant to the overall plan. These linkages are important for ease of protection and maintenance as well as to increase the sense of expansiveness of a user who is able to travel long distances without encountering developed areas. Linkages also provide safe travel routes from residential areas to the larger parts of the open space network.

Open Space Plans are really feasibility studies. They describe the relative importance of broad areas within a town and define an ideal scheme for local and regional resource protection. It should be understood that all areas with some degree of open space priority cannot necessarily be acquired or protected.

The Conservation Commission and the Town can use the Plan and Resource Inventory as guidelines for land acquisition, concentrating immediate purchase and protection efforts on first priority areas. Concurrently, lands which become available can be compared to the Plan to establish their relative importance to a total scheme.

The Priority Plan for Open Space should be thought of as a flexible scheme; it can be changed and

reworked by the Commission as priorities or conditions within the Town change. The Commission now has a substantial resource base to aid in making future decisions. The present Priority Plan for Open Space should be considered carefully. If accepted, and implemented even in part, it will begin to provide the needed balance between developed land and the natural resource base.

Bikeways: An Historic Bicycle Tour

There has been a growing demand in this country for bicycle facilities. Bicycles provide a cheap and pollution-free alternative to short distance transportation by automobile in this year of energy crises; and they are of excellent physical fitness and recreational benefit.

Middleborough's gentle topography and rural quality provide the ideal setting for a network of bicycle trails, especially in conjunction with its open space planning. Much local interest in bicycling is evident from the Preference Survey and from discussions at local meetings. Bikeways could provide or coincide with linear "linkages" proposed in the Priority Plan for Open Space.

Bikeways should be considered as part of the larger transportation system, and should be designed to reflect this relationship. The time is appropriate for bikeways to be incorporated into the Town's existing street system. Middleborough has a unique opportunity to offer a regional recreation alternative. Because of its large areal extent and proximity to major urban centers, the Town could serve a regional demand for bicycle trails in scenic rural areas. At the same time, a bicycle network could knit together the Town's open space fabric.

In conjunction with the country's Bicentennial, a great deal of tourism is expected in Massachusetts. The rich historical heritage of Middleborough will undoubtedly be a drawing card, and the Town could use this to its advantage by providing an Historical Bicycle Tour. This could involve a cooperative effort with neighboring towns; it might also coincide with the designation of local scenic roads. A self-guiding brochure could be published, with a map of the tour route and a descriptive listing of points of interest where cyclists might want to stop. The brochure could be available at the Town Hall or at a tourist information booth. Local residents who are relatively new to the area or those who want an alternative to the Sunday family drive would also find this appealing.

The Regional Field Service team would like to recommend the Historic Bicycle Tour as a cooperative effort among Town agencies. The federal League of American Wheelmen and the Bicycle Institute of America, as well as the Environmental Protection Agency and the U.S. Department of Transportation will assist local communities in formulating bicycle route plans, as well as provide safety and construction standards.

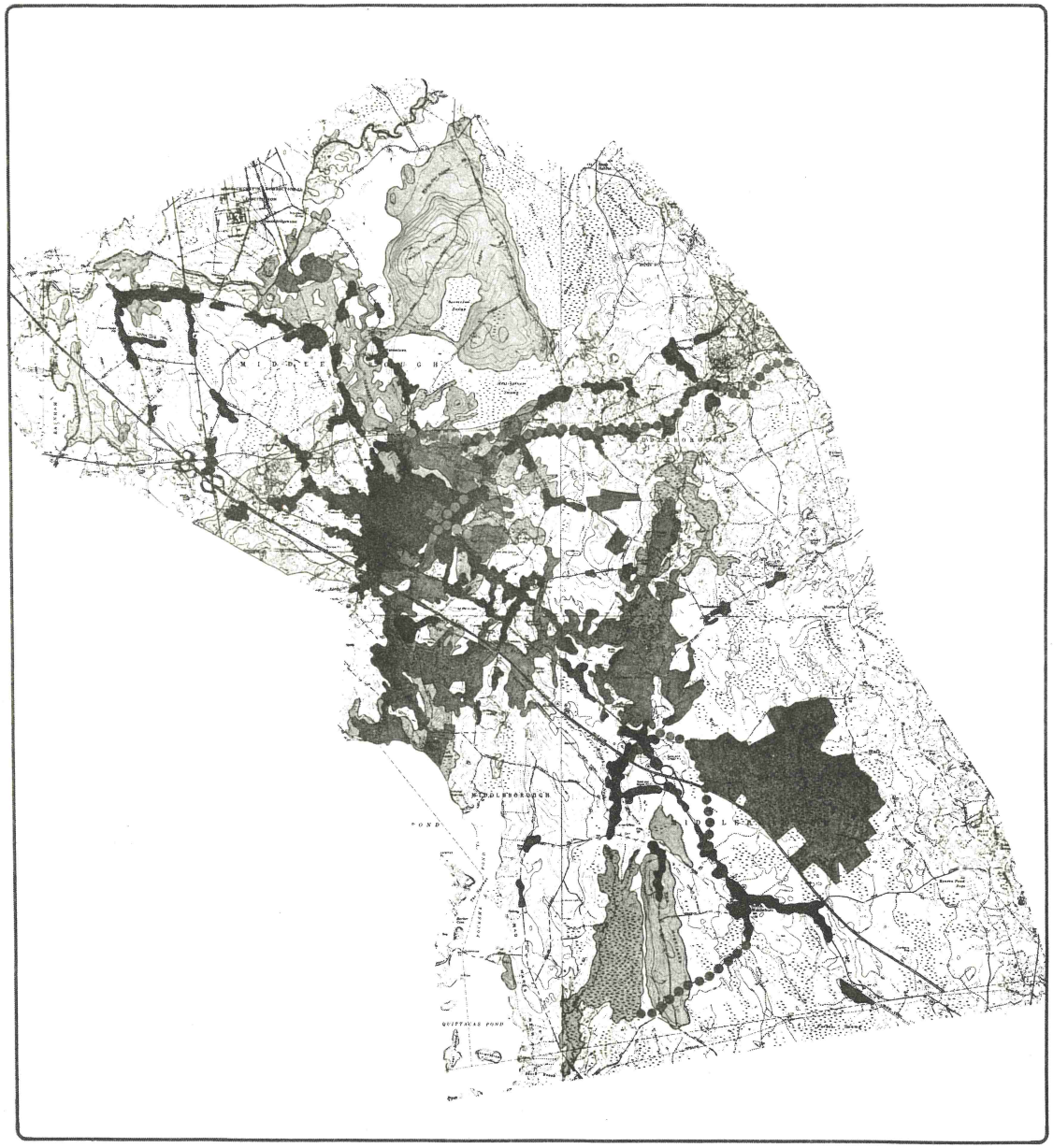
Priority Plan for Open Space (Map 13)

Interpretation: The Priority Plan for Open Space was established by subtracting, from the Resource Composite Map, lands which were either developed parcels or existing open space parcels. Lands which remained were essentially undeveloped and unprotected resource-rich areas. These were sorted into first, second and third priorities on the basis of Town Goals and projected development pressure as indicated by the Development Demand Map.

Use: A guideline for future open space acquisition and protection, to establish a balance between developed land and the resource base.

Sources: Resource Inventory Maps, Resource Composite Map, Existing Open Space Map, and Development Demand Map; preference survey to establish Town Goals.

Legend:



Middleborough Open Space Plan

Map 13: Priority Plan for Open Space

10 square acres

1 square mile

0 1 2 3 4

scale in miles

north

5
THE NEMASKET RIVER

The Nemasket River cuts a unique cross-section through the Town of Middleborough. It winds among natural and man-made landscapes, offering a diverse visual experience to the canoeist. There is the hard-edged urban area, where intensive land use crowds the river's banks; it is here that strong development guidelines will be most necessary. In close proximity, however, is the rural countryside, with its cultivated fields, grazing cattle and scattered homesteads; swamps and wooded hillsides enhance its rich character. Now and again, the river enters a natural area where the forest prevails, or where steeply sloping banks close in and create a sense of remoteness. These are prime wildlife and wilderness areas. Between all of the river's major zones are less definite boundaries: transitional edges of vegetation or bridges or developed areas which provide a momentary shift in mood. Each of the Nemasket's "character zones" is unique; and all deserve special consideration in open space planning.

As part of the Middleborough Open Space Plan, certain "design linkages" were recommended. Perhaps the most outstanding of these is the Nemasket River, and the Regional Field Service Team felt that it deserved special consideration. The river is a resource which lies wholly within Town boundaries; it ranks highest in open space priority with local residents. At the same time, its annual herring run and spring canoe races appeal to a much wider population. An analysis of the conservation and recreation potentials of the Nemasket River Corridor will illustrate the usefulness of the preceding Resource Inventory for planning at a smaller scale.

The Nemasket lies on a glacial outwash plain and drains from Assawompset Pond at 58 feet above sea level north to the Taunton River at 10 feet above sea level. Soils are generally coarse textured, except in areas of low relief where fine-grained organic soils accumulate. Much of the principal groundwater supply in the Town of Middleborough underlies the river channel, suggesting that pre-glacial drainage systems followed similar courses in many places. Woods Pond and Tispaquin Pond are directly linked to the Nemasket River by Fall Brook and its associated wetlands.

The Natural Resource Composite Map delineates areas of critical environmental concern along the river. Groundwater pollution potential was mapped by combining the principal aquifer areas (300+ gallons per minute yield) from the Groundwater Availability Map with areas of glacial outwash and droughty soils from the Surficial Geology Map and the Soils Map respectively. At this scale, the second level of groundwater yield (100 to 300 gallons per minute) might also be included to obtain the relative importance of different sites along the river. Vulnerability to surface water pollution was determined by an overlay of the Soil Capability Map (Erosion Potential) with the Surface Hydrology Map. Wetlands and Vegetation Maps were used in combination to determine areas of potential wildlife habitat; wetlands associated with upland fields and pastures going into succession would provide the most ideal sites. Unique areas and significant wetlands were mapped from the Unique Resources Map and the Wetlands Map, respectively.

When the Natural Resource Composite was compared to field checking results, four major areas emerged which seemed to offer the greatest open space potential. These were: Lion's Neck, near the mouth of the Nemasket; the Oliver Mill Park area, off Route 44; Barden Hill, near the downtown area of Middleborough; and the Merle Washburn Conservation area, near Assawompset Pond and the river's source. (Figure 13) The study team felt that, with a minimal degree of development, these areas could offer maximum recreational use as well as maintain their conservation functions. Two of these areas, Oliver Mill and the Merle Washburn property, are presently owned by the Town. Lion's Neck and Barden Hill should be given serious consideration as possibilities for future acquisition as part of the Town Open Space Plan.

Site development of conservation and recreation areas should be compatible with the degree of sensitivity of the local environment. Certain natural resources are more sensitive than others

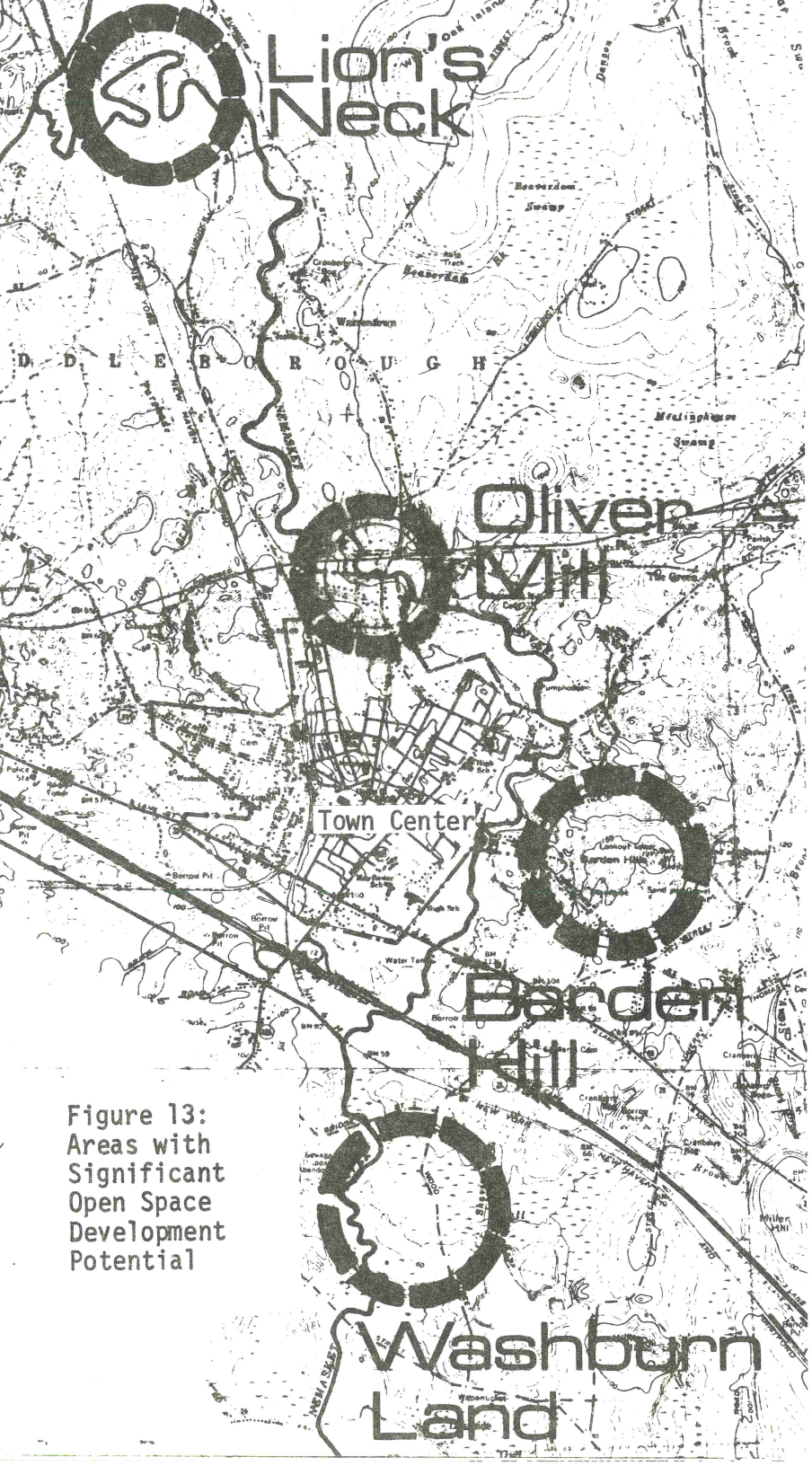


Figure 13:
Areas with Significant Open Space Development Potential

to the level of activity which occurs on a given site. In general, conservation areas are established because they offer the most assured protection of the resource base, while recreation lands are chosen to take advantage of site characteristics and location. The matrix in Figure 10 illustrates a typical compatibility relationship between activity levels and various types of conservation and recreation land uses. Such relationships are useful in deriving multiple usage from one site. More intensive levels of activity, housing or industrial development for example, should be restricted to areas which are not environmentally sensitive.

The Barden Hill area can serve as an example for smaller scale schematic development plans for conservation and recreation areas. It is evident from the Resource Inventory that Barden Hill serves many functions. It is situated directly over a principal aquifer area. Its soils are in the "well-drained" category, making it a groundwater recharge area as well. It is a unique geologic landform (kame) and it is the site of an early Indian encampment. And, finally, it offers a visual panorama of the Town from its summit.

Once the relative value of a site is determined, local planning bodies should begin to consider Town goals and priorities. Of all the aforementioned functions of the Barden Hill area, water resources would probably rate highest in priority among local residents. Therefore the intensity of land use allocated to the area should respect its most important function: a groundwater reservoir and recharge area. The matrix in

Figure 14: LAND USE/ACTIVITY TYPE COMPATIBILITY MATRIX

Land Use	Associated Activities	Level of Impact	Resource Category Most Compatible with Land Use
Conservation	Limited hiking, nature study	Low: no impact	Wildlife, Unstable Soils, Surface Water
Passive Recreation	Picnicking, hiking, tent camping, fishing, hunting	Moderate: erosion hazard from trail construction and use; noise impact	Wetlands, Unique and Historic Sites, Groundwater Recharge Areas
Intensive Recreation	Tennis, golf, pool swimming, playfields	High: runoff from paved areas and playfields increased; high fertilizer, pesticide and salt content; siltation of surface water during construction and use; noise impact	Forest Vegetation, Stable Soils

Figure 14 indicates that a moderate level of activity would be compatible with the protection of a groundwater recharge area. Therefore, hiking, tent camping and picnicking would be the most appropriate uses. By retaining the Barden Hill area as a moderately intensive recreation area, the Town can achieve dual purposes: the conservation of its water resources and the expansion of its recreational facilities.

The Merle Washburn conservation area presents a different set of problems. It is an area of deep and shallow marshes surrounded by dense forest and wooded swampland. Its primary function has been that of high quality wildlife habitat, and for this reason a relatively low level of activity is recommended. Nature study and some limited hiking could be accommodated by a floating boardwalk trail connecting the many wooded islands. More intensive levels of activity would not be compatible with the resource base.

Both the Lion's Neck and Oliver Mill sites can accommodate moderate recreational activity. Lion's Neck is actually an "oxbow" meander in the Nemasket River, which is relatively unique in the New England landscape. The area would be an ideal picnic spot accessible only by canoe or a vantage point for the annual canoe races. The mill stones, sluiceways and stone foundation of Oliver Mill date back to the Revolution when the mill, owned by a British loyalist, was destroyed. The site has fulfilled its land use potential as a picnicking and fishing spot, but it needs additional planting to screen it from Route 44 and a pedestrian trail access to connect it to the Town center.

It is important to consider the Nemasket River Corridor in terms of long range acquisition plans. Priorities for future purchase and protection can be established from the Composite Natural Resource Map, the Development Demand Map and the Existing Open Space Map. Top priority should be given to those areas which encompass the most natural resource categories, which are in closest proximity to rapidly developing or developed areas and which can be made to adjoin existing open space lands. This strategy was used to develop the Priority Plan for Open Space. Figure 15 suggests some long range priorities within the river corridor.

Strong implementation measures can often protect critical resource areas, avoiding the need to purchase many acres of land. Floodplain and wetland zoning could be used to great advantage along the Nemasket. Performance standards, such as set back requirements, with a periodic review by the Conservation Commission would also be useful tools to insure the longevity of the river.

Before final site acquisition and development plans are drawn up, however, the Conservation Commission will want to enlarge the inventory maps in the particular area of concern, and update them if necessary. The most accurate method for updating is the use of aerial photographs, which are available at the Massachusetts Department of Public Works. They were flown in April, 1971 at a scale of 600 feet to the inch. They can be used to delineate such things as landform, soil types, wetlands and vegetation types more accurately. At this scale too, it

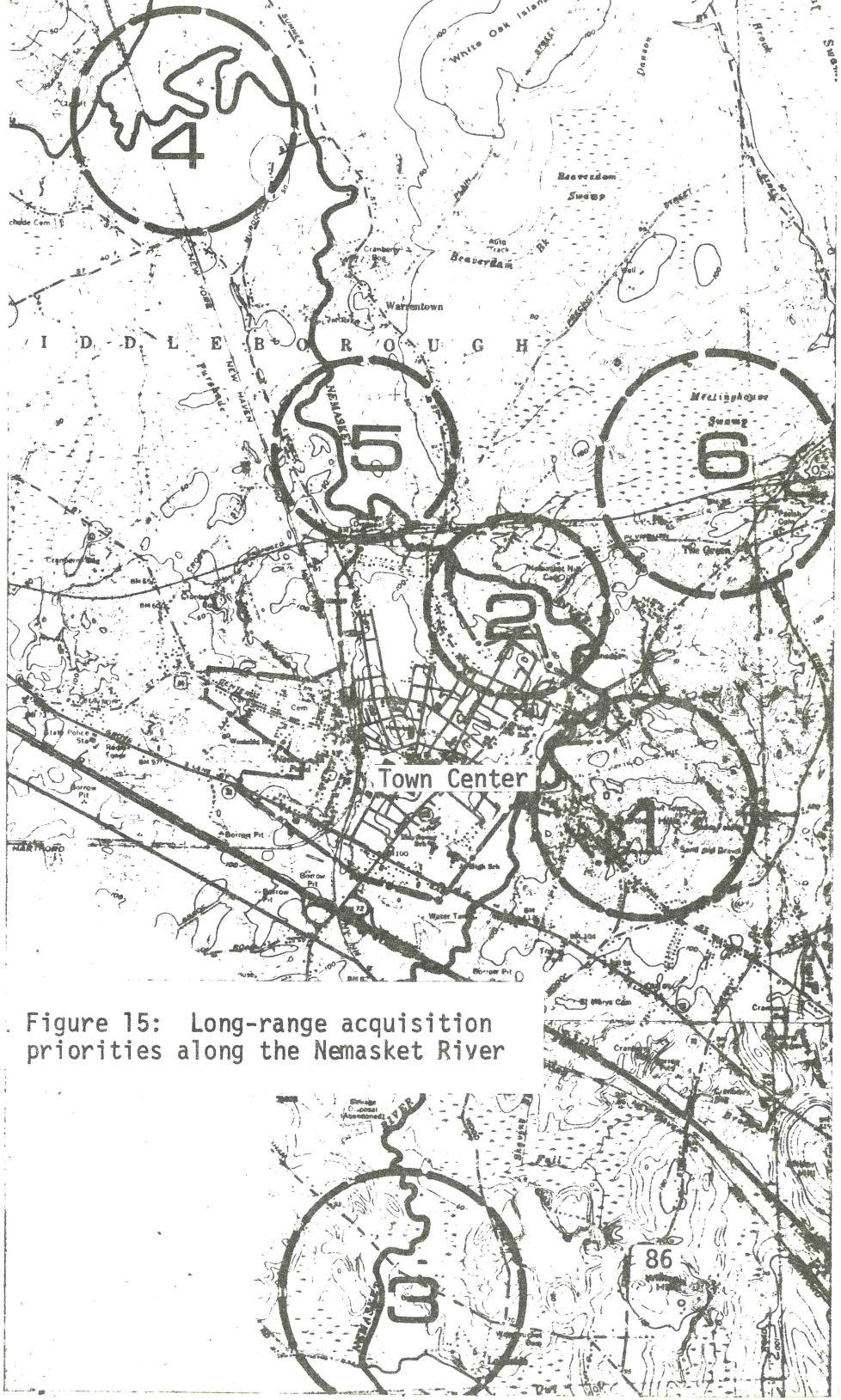


Figure 15: Long-range acquisition priorities along the Nemasket River

will become feasible to delineate land ownership from Town assessor's maps. This can be done as an acetate overlay on the aerial photographs. Land ownership relates directly to the type of implementation strategy most appropriate for each parcel.

To be maintained as a high quality environmental area, the Nemasket River will need a certain level of management. The summer months bring such a drastic lowering of the water table that the river is not navigible in some places. Wild rice and other aquatic vegetation chokes the stream channels during periods of low flow which coincide with the height of the growing season.

It would be advisable for the Town to consider some form of low-flow augmentation for the Nemasket, to increase recreation and wildlife potential as well as visual quality. Potential dam and empoundment sites are suggested in the 1970 Natural Resources Study by the Plymouth Conservation District. Increased water levels will not only allow year-round recreational enjoyment of the river; it will soon enhance wildlife ecosystems in adjacent wetlands. The process of wetland succession (whereby a deep marsh becomes a shallow marsh, then a shrub swamp and, finally a wooded swamp) has resulted in many acres of purely wooded swamp in Middleborough. The wildlife potential of wooded swampland is not as great as that of marshland. A higher water table would be intolerable to woody vegetation. It would die back and deep and shallow marsh vegetation would begin to dominate.

Power lines, which transect the Town also span the river in many places. If untreated with herbicides, the cuts furnish valuable edges of new growth which are of primary food value to local wildlife. They also provide hiking trails, although recent vandalism has caused a restriction on this use in Middleborough. Visually, however, power lines do damage the river environment. In this context, management practices might alleviate visual disturbance: portions of the power line rights of way along the river's edge could be allowed to revert to their natural state.

The Nemasket River ecosystem can answer the need, locally or regionally, for other-than-classroom educational facilities. It is available for continuous study with no cost or elaborate arrangement. As a natural system, it continually provides the unexpected: insect activity, soil profiles, the cycles of animals and the seasons of plants. Long range plot studies can measure environmental change and show how human activities effect and are effected by the natural. The river ecosystem offers a sensory experience which can inspire a prudent attitude toward the use of a renewable natural resource.

The Nemasket could profit from some public relations work, to encourage a committment to its preservation. One of the first environmental education programs should be based on the river and its value to the Town. Such a program could describe in detail the natural origin of the river and the dynamic forces which make it flow northward. A slide show depicting the canoeist's view as he travels the river's course might be a project that

would interest local high school students. A taped sound track could be added to create a sense of reality and to describe the journey. Such an audio-visual project could be circulated through the schools or made available at the Town library.

The protection of a river in a rapidly urbanizing town can only be accomplished through the cooperation of many agencies and individuals. The villain is not land use alone, but the combination of an inadequate sense of need and poor implementation techniques.

The fragile natural environment which forms the Nemasket River and its watershed is a unique resource. The ecological processes which define the resource link public and private interests. Its greatest threat is thoughtless and uncontrolled land use. Limitations and controls will be necessary to protect the health, welfare and safety of the people of Middleborough, to promote a free-flowing river condition, to insure fish and wildlife resources, water quality, scenic quality and historic and recreational values. Preservation of the Nemasket River Corridor will serve the Town, the region and future generations.

Recommendations:

Investigate model floodplain zoning ordinances to provide public control of the river banks.

Establish performance standards for development, with periodic review by the Conservation Commission, even in non-critical areas along the river.

Stabilize present land use along the river.

Direct proposed harmful land uses to areas in Town where environmental conditions are less sensitive.

Regulate land use along contributor streams.

Produce an environmental education program about the river.

Implement a plan for low-flow augmentation.

6
IMPLEMENTATION STRATEGIES

IMPLEMENTATION STRATEGIES

The previous sections provided data and procedures that the Conservation Commission can employ to determine its goals and to reach decisions regarding land use and land acquisition. This section discusses some of the ways these decisions can be implemented. The Commission is already familiar with most of this material. Many practices listed here are already in effect, but are mentioned for the sake of completeness.

The Conservation Commission

Staff:

One prerequisite to effective effort is a commission composed of dedicated individuals. The work of the Commission will be greatly eased if each member can be relied on to contribute in some substantial way. Allocating separate areas of investigation and responsibility among members will enable the greatest amount of work to be done in the most efficient manner.

To the extent possible, members should have or acquire knowledge in areas relevant to the Commission activities, such as natural sciences, law, finance, education, construction and development, local history and wildlife, and public relations. Alternatively, local people whose work lies in these fields and who are sympathetic to conservation should be contacted to volunteer advice when necessary. No single volunteer needs to do much, but together they could be very helpful and could take a great deal of the work load off the Commission.

Communication With Special Interest Groups

The Commission should represent not only a variety of skills, but also a variety of groups, such as kennel clubs, 4-H, women's associations and church groups. Ideally the Commission is in touch with a wide range of community associations through which its aim can be publicized and support enlisted. For such a communications network to be formed, the Commission should seek members from different parts of Town who are influential in different social circles.

When a member's term expires, the Commission should assume an active role in suggesting a replacement who brings the skills, background, and connections that are being lost. In the case of resignations, the Commission should certainly exercise its perogative to nominate and elect a new member in a joint meeting with the Selectmen. If the Commission keeps in touch with Town groups, informing them of its activities and of ways in which they can help, it may find that these bodies form a supply of future members already well acquainted with the work of the Commission.

Communication With Town Agencies

The Commission should keep in touch with not only large and possibly helpful clubs, but also with the other branches of Town government. Frequently the Commission will need the cooperation and advice of other agencies, which are more likely to help if they are already aware of the Commission as an active governmental body, and are

familiar with both its long range goals and its specific projects and deliberations. Sometimes other Town departments will want the support of the Conservation Commission, for example for park development or the preservation of historic sites, and so they should be made aware of the Commission as a potential ally.

To maximize communication with other Town departments, the Conservation Commission should exchange minutes with each board. The minutes should be brief, and yet written with an eye to informing outsiders of the purpose and the importance of Commission actions and proposals. The minutes should conclude with an announcement of the agenda for the following meeting, so that interested individuals can attend. The minutes might also be posted in several display areas maintained by the Commission at key locations, such as the Town Hall, library and high school.

The Commission should hold joint meetings once a year with each town board. This is probably the single most effective way to learn the plans of other Town departments and inform them of the goals and needs of the Conservation Commission. At such meetings, areas of mutual concern could be pinpointed and cooperative efforts planned. Similarly, areas of antagonism could be brought into light, so that conflicts could be resolved or plans adjusted without encountering unexpected resistance at more critical stages of proposal implementation. Also, redundant efforts could be eliminated, with one agency or the other assuming responsibility.

Members of the Conservation Commission might seek appointment to other relevant departments, or vice versa. A personal liason would maximize interawareness among the two groups and greatly facilitate coordinated efforts. Such cooperation is becoming a drawing card for state and federal funds; projects serving several purposes at once are more likely to be funded. For example, combining public recreation space with an historic preservation area or with a water retention zone. Alternatively, members of the Conservation Commission could be assigned to cover the meetings and activities of other Town groups, including not only Town departments but private associations as well. Such an assignment would not necessarily entail more than examining each particular group's minutes and reporting to the Commission activities and opportunities significant to Middleborough's conservation plans.

Communication With Adjoining Towns

The Commission should also keep in touch with the Conservation Commissions of neighboring towns. Frequently the areas that are the best suited for preservation or recreational development, such as river banks or highlands, serve as municipal boundaries. Yet towns commonly fail to develop or to acquire such areas out of jealousy and fear: jealousy that the neighboring town will reap a benefit for which it does not pay, and fear that it will develop its side of the line in an incompatible manner. Cooperation between adjoining towns can solve this impasse. Joint projects can be conceived on a bigger scale that enhances the individual contribution of each town. For example, for a town to have a riverside park is very nice, but to secure both shores is more than

twice as pleasant. In essence, towns should look upon the possibility of cooperating with their neighbors as a way to match their expenditure with an outside grant. Furthermore, financial aid from the state and other agencies with a regional purview may in fact be more readily forthcoming for projects that display inter-municipal cooperation.

To maximize communication with other towns, minutes of Commission meeting should be exchanged in the manner discussed above, perhaps with matters of particular interest marked in the margin. Even if the minutes do not deal with proposals for joint action, they should prove a source of ideas for conservation projects and techniques. Joint meetings might on occasion provide the impetus for definite action. In addition, one of the members of the Commission might go farther afield to research what other Boston area towns have done. An investigation of towns under greater development pressures than Middleborough would provide a wealth of information and ideas.

Public Relations

It is in the area of public relations that the Conservation Commission can probably accomplish the most for the least cost. One of the Commission's primary goals should be to create a generally favorable climate for conservation. If Townspeople and other Town departments can be convinced of the validity and importance of the Commission's concerns, then the job of building support for a particular land acquisition will have been half accomplished.

In general, the initial phase of public relations work should not be on behalf of a particular proposal to acquire land. Rather, it should aim to promote the overall concepts, methodology, and goals of the Commission, which very few people will want to quibble with. As they learn about the Commission's activities, the Townspeople will almost certainly be glad that such an organization is at work. A particular proposal, on the other hand, could generate unfavorable controversy over the price before people have gained an adequate understanding of the purposes and logic behind conservation.

Environmental Education Committee

Public Relations covers such a wide range of opportunities that the Conservation Commission could easily spend all of its time doing nothing but educating the Town about the value of conservation. The establishment of an ancillary Environmental Education Committee would relieve the Commission of this drain on its time. Such a committee could be headed by a member of the Commission, but would otherwise be composed of associate volunteers with no official connection with the Commission. In essence, it would be another club or association that shares the concerns of the Commission and works to promote its goals. Such a body would greatly expand the working force of the Commission. It would allow people eager to serve on the Commission but not officially appointed by the Selectmen to participate nonetheless. It would provide a pool of future members already acquainted with the tasks and demands of the Commission. It would allow people to participate on a less time consuming

basis than full membership, and so make volunteering an attractive proposition, as no single person would be asked to burden himself. The educational work would by its nature demand a good measure of expertise and creativity, and hence could be quite challenging. It could take many forms and appeal to many people with interest in a wide range of skills, like photography, writing, graphic presentations and public speaking.

Exhibits

There are a number of simple projects that the Conservation Commission or an associated committee ought to undertake to alert the Town to the need to act now, while the opportunity is greatest, to preserve key areas for recreation and the protection of wildlife, water supply, scenic views, rural quality and other values important to the Middleborough residents. One simple step has been mentioned before: setting up public displays in prominent places throughout the Town, such as Town Hall, the library and the schools. Such show areas should not be temporary. They should be spaces permanently allocated to the use of the Commission and they should feature exhibits that change every few months. Such exhibits need not be fancy or time consuming to prepare. Much of the necessary information can be drawn from this report. They could present the previous series of inventory maps as eye-catchers. They could focus in turn on different parcels of land that the Town already owns or proposes to buy. They could include a few handsome photographic enlargements showing the amenities of each area. Historical artifacts, plant pressing and other curiosities could be included. Text and diagrams could explain the importance of the areas of the Town. Each parcel could be used as the focus for a lesson in geology or ecology. The exhibits could concentrate on a series of problems confronting Middleborough, such as scattered subdivision development, or the absence of neighborhood playgrounds in some areas. At the same time, possible responses like cluster-zoning could be explained and aired.

In short, there are any number of themes that could provide the focus for a series of exhibits. In addition, the exhibits could display books, dust jackets, and a list of readings in the general area of natural history, ecology, conservation, and nature lore and appreciation. The high school and Town libraries could feature a special shelf of literature connected with conservation. Such books have great inherent appeal, and are an excellent medium for alerting people to the values of conservation, whether from a scientific, aesthetic, humane or historical point of view. Finally, such exhibits should include a posting of the Conservation Commission minutes, so that people can come to understand its day-to-day work.

Newspaper Column

Another step that would help to create a climate favorable to conservation would be the creation of a weekly nature and wildlife column in the local newspaper. Such a series could deal with all the aspects of nature appreciation and outdoor life that such columns usually do: the changing season, the weather, the migration of

birds, local hunting and trapping, as well as local hunting and fishing adventures of Town residents in their excursions farther afield. In general, it could create enthusiam for the pleasant rural quality that Middleborough possesses today. It could also describe conservation tracts held by the Town, and discuss their charms, vegetation, and wildlife--in short, what to do and look for when one goes there. It could describe the efforts and the aims of the Conservation Commission, and reiterate and enlarge upon the arguments justifying the preservation of open space in general and of proposed acquisitions in particular. In short, such a column could on occasion serve as an organ for the Commission through which to present its case to the entire community. To give the column a consistent voice and identity, it should be the responsibility of a single individual, either a commission member or someone who kept closely in touch with the Commission and shared its views. Or the column could rotate among authors, which would allow more people with a wider range of expertise to participate, and would not burden any one individual.

Publications

In order to make the most of what already has been accomplished, the Commission should publish a document of its own providing information on existing Town lands, for local residents and visitors alike. Such a pamphlet could contain a series of maps of Town properties, with information on how to get there and where to park. The cost of the pamphlet could be defrayed by charging a modest price such as one dollar.

The pamphlet should encourage the active use of the areas for walking, picnicking, and nature study. It could include a brief discussion of each area's natural history and of its values for conservation purposes as well as any other short lessons in ecology and land use that the Commission may want to emphasize. The pamphlet should stress the Commission's role as a responsible custodian of conservation land, and should include a brief discussion of the financial and tax benefits to private landowners of giving land to the Town, as well as ways in which owners can maintain an interest in their land through their own lifetime or that of their children.

The Commission should let no opportunity pass to impart an enthusiastic attitude toward its accomplishments and its plans. People are excited by enthusiam and want to help. One such channel is the Annual Town Report, which the Commission should use as an opportunity to list its holdings and their value to the Town, as well as to describe current and future efforts, and the benefits that will follow from them. Another opportunity is national occasions like Earth Day, which the Commission should push in the papers and schools.

The conservation commission should also distribute material written by other groups that play an active role in conservation. For example, the Massachusetts Audubon Society publishes many pamphlets explaining the value of wetlands, groundwater, open space, conservation legislation and other environmental matters. The Department of Natural Resources distributes free newsletters devoted to the same subjects. The Conservation

Law Foundation will send free reprints of short articles upon request, while membership in the Foundation includes a monthly newsletter, the Annual Reports of the Trustees of Reservations, and very informative booklets that will fill the reader with enthusiam for the work that is being done. The Commission should display some of these documents in its exhibits and provide copies for the Town library. It should also arrange for their distribution in the science classes in the Town's schools. Many movies are also available that would help to draw crowds and to cultivate an appreciation of nature.

Performance Recommendations

In an effort to encourage homebuilders and developers to employ methods that respect the environment, the Conservation Commission may want to issue information illustrating design practices and performance standards that minimize impact on the natural setting. Such information could be presented in exhibits or as part of a Conservation Commission booklet. Aspects of subdivision design, house siting, construction practices, building materials, and planting could be covered.

The Commission may also want to develop examples or restrictive covenants that developers or neighborhoods can use to enforce a degree of aesthetic control within their subdivisions. Such controls, covering building materials, extraneous structures, maintenance of views, and other such matters which usually enhance the value of the development.

Lectures

In the same vein, the members of the Conservation Commission or of an associated Environmental Education Committee should prepare informal talks and slide shows for presentation to different Town groups, such as schools, church groups and women's clubs. A slide file has been kept by the study team and has been turned over to the Commission. Slide lectures could present much the same material as just discussed regarding exhibits, a newspaper column and a pamphlet.

The Schools

The schools offer a promising opportunity to build support for local conservation. Many adults living in Middleborough today are graduates of local schools, and this pattern is likely to continue. If future voters have been educated in the schools as to the intricacies of the inter-relationships between man and nature, between wildlife and its habitat, between water quality and development, or if they have been alerted to the historic significance of local structures, highways and rivers then they are more likely to appreciate the point of view of the Commission in years to come. Nor is it necessary to wait until the distant future for such benefits to appear. Frequently one of the most effective ways to communicate with adults is through their children, who can raise the consciousness of their parents in regard to ecological concerns and practices. The use of the Town's historic sites and natural areas as an integral part of the educational program also provides visible

and powerful evidence of the value of preserving such areas.

Both teachers and students form an important pool of potential volunteers for conservation work. Teachers are practiced at presenting and explaining material, and their fields of specialization may be in areas relevant to the Commission's concerns, such as history and the natural sciences. Students can lend valuable assistance in many ways, such as by searching Town records, conducting research on local history and environmental matters and helping with field inventories. Course projects in high school history and biology might take a form that would be of value to the Commission. For example, student projects could consist of preparing some of the materials mentioned previously: a pamphlet discussing the history or the ecological systems of a particular site, or a slide show devoted to the same subjects. Chemistry classes may want to track down sources of stream pollution. History classes might carry out an 'archeological' investigation of old cellar holes. Elementary classes could conduct plant inventories and make plant pressings. Students would know that their work had a purpose beyond the classroom, if it were to be exhibited in the Conservation Commission displays. Student apathy is always a problem, and the Commission should not try to involve great numbers of students at the outset.

Regional Service Groups

Special interest associations and regional service groups that are based outside Middleborough can also be of help. For example, the Conservation Law Foundation in Boston is a source of legal assistance as well as of pertinent literature. The Foundation staff will provide strategies for legal action, give advice on applicable laws and protective techniques, furnish models of statutes, ordinances and by-laws, advice on funding procedures for acquiring land for conservation purposes, and supply references to lawyers who have dealt with certain environmental issues. The Foundation disseminates current data on by-laws of various Massachusetts towns and cities, with comments on their success or difficulties. Some of the types of laws on which they are collecting information include: floodplain by-laws and other municipal wetlands regulations, including the appointment of a local conservation enforcement officer; laws regulating subdivisions, earth removal, outdoor signs, snowmobiles, road salting and insect control; the designation and protection of scenic roads and historic districts; and park protection laws.

Other regional groups with which the Conservation Commission should establish a cooperative relationship are any conservation land trusts that may be active in the area. The outstanding example is the Trustees of Reservations. The recently founded Plymouth County Wildlands Trust is another potential conservation partner. Such land trusts, which are in fact private corporations chartered by the State to acquire and hold land tax-free for conservation purposes, specialize in soliciting gifts of land. Their staffs are very knowledgeable concerning the tax advantages of giving land and are experts at the face-to-face negotiations involved. The Conservation Commission

should put them in touch with possible donors in Middleborough. If open space can be preserved by like-minded conservation groups at no cost or effort to the Commission, so much the better. The Trustees of Reservations can also help by providing a low-interest loan from its revolving fund administered by the Land Conservation Trust, an allied entity.

Municipal Land Trust

If private land trusts cannot be interested in devoting some of their effort to Middleborough, the Conservation Commission may want to encourage the creation of a new land trust devoted specifically to Middleborough, as has been done in many other Massachusetts towns. A Middleborough Land Trust could specialize in seeking gifts of land. Of course, the present Conservation Commission is already empowered to solicit and to receive gifts of land, but a new land trust might have the advantage of awakening the interest of some of the Town's most landed citizens. It could be their own thing, an extension of their own clique. It could be used to both their and the Town's advantage by allowing them to make gifts of land when they wanted, to be off-set against their income, while the Townspeople would receive the right to use the land under appropriate restrictions. Such land trusts could also, like the Commission, be the recipient of limited easements, which would have a substantial value for tax purposes, yet not necessarily entail public use of the land.

EXISTING TOWN LAND

Before the Conservation Commission seeks to acquire new land, it should make sure for the sake of both efficiency and good public relations, that it is deriving maximum benefit from the land that is already in the Town's possession. It should work with other Town departments to establish access to and across all Town land, whether the land is actually administered by the Commission or by the Department of Public Works, or the Middleborough School Committee or some other department. Hiking trails need not pass near school buildings or near dangerous or delicate equipment. They can be sited along the fringes of the property. For example, Town residents should be able to walk along the bank of the Nemasket River at the edge of the land occupied by the water pumping station, thus providing a link to Town conservation land farther south. In fact, the Town Water Department has proposed such a path along the west bank of the Nemasket. The Commission should work to gain administrative control over all Town land serving a conservation purpose. Such a step will prevent the diversion of the land to other purposes without approval of the Commission. As further protection, the Commission should make sure that the warrant to acquire each parcel or the motion to transfer its control to the Commission includes a statement describing the conservation and park purposes which the land will serve. This will give the tract greater protection under the doctrine of prior public use protecting parklands, reservations and kindred areas in cases where County

or State agencies seek to take the land by eminent domain.

Tax delinquent properties merit close investigation. Typically, such land is of little commercial worth and so has been let slide by the owners. However, commercial wastelands such as swamps and bogs may serve valuable conservation purposes as wildlife habitat, stream siltation traps, and flood storage areas. Every parcel of tax delinquent land should be located, and the largest should be inspected. Areas of value for conservation purposes should be acquired by the Town through foreclosures or eviction and then placed under the administrative control of the Commission. As will be explained later, even a small parcel can serve as a proprietory base from which to take legal action against neighboring abuses. Town owned lands which offer space potential are listed in the Appendix to this report.

The Purchase of Land

The Conservation Commission will almost certainly want to recommend that the Town continue to purchase land for conservation purposes. Ownership of land is in some cases the only means to obtain the protection of privileges that are desired, particularly where active use of the area by the public is sought or where the goal is to prevent all alteration of the natural environment.

However, the purchase of land is also the single-most costly approach to preserving the countryside. Before buying land, the Commission should determine whether it can achieve its end some less expensive way. For example, if all that is wanted is the right of the public to walk from a road to a piece of Town land without frontage, this privilege might be gained by the purchase of an easement. If what is wanted is the protection of an historic area, this goal might be realized through historic district zoning. The employment of easements, restrictions and zoning to achieve specific objectives is discussed later.

If the goal that is sought can be achieved only by acquiring the entire interest in the land, the Commission should try to obtain ownership through a less costly means than purchase. It should first try to interest the owner in giving the land in return for the various tax advantages he will receive. One member of the Commission or of an allied group should make it his specialty to become knowledgeable and persuasive in this regard. If the Commission must buy the land, it should of course make sure that it is getting the most for its money. It should comparison shop between alternative parcels. It should consider first areas which serve multiple purposes. It should also consider the externalities of the situation: which parcel ties in best with the surrounding uses, present or possible; which is more costly in terms of revenues lost to the town, or less costly because of adjoining residential areas to which betterments can be assessed. The Commission should not restrict its deliberations to land which has been offered for sale. Rather, it should determine its goals, interpret them into restrictions, privileges, and ownership of certain parcels or categories of land, and then

approach the owners with proposals aimed to achieve those goals in a mutually acceptable manner.

Eminent Domain

In some cases a parcel may be so attractive that the Commission will want to recommend that the Town employ eminent domain to acquire the parcel if the owners are unwilling to sell. Although such an action can create ill will, it should still be considered where the gain is truly outstanding, as may be the case in property abutting ponds and rivers. Furthermore, the interest that is taken need not be the whole interest. Once again, the Town could obtain a limited easement in this manner. To avoid the possibility of being caught in a costly court decision, the Town should employ so-called 'second chance' eminent domain, whereby the taking is not finalized until after the award has been determined in court. This approach is particularly appropriate where easements or wetlands are taken, and hence the value of what is being condemned is hard to determine ahead of time, and may be settled at a very low or large sum.

Options

If the Commission decides to pursue a purchase, it should obtain an option even from the friendliest of sellers in order to freeze the price while the Town deliberates whether to go ahead with the bargain. Otherwise the price may rise as the desire of the Town to buy becomes increasingly apparent. The fact that the price is settled should also add to the appeal of the property in the eyes of the voter. If the owner asks for more than a nominal sum for the option, the land should only be purchased if it stands an excellent chance of passing a Town Meeting.

Financing Land Purchases

The traditional way to pay for a large cash purchase is to use funds specifically appropriated for the purpose by the Town Meeting. This procedure is also very time consuming and is likely to entail a repeated struggle over every recommended purchase. What is needed is a way for the Conservation Commission to act on its own initiative and prerogative.

Installment Buying

One way to do this is to buy land on the installment plan: so many acres a year for a given number of years, until the parcel is entirely purchased. Or the owner may wish to sell an undivided interest; for example, ten percent a year. This approach, of course, does not provide the Commission with any additional funds beyond what it already had from its standard yearly allocation. Eventually, also, the Commission must pay the full price. However the technique does allow the Commission to buy on its own, over a number of years, pieces of land which it could never afford all at once, or which the town would not approve because of the need for a special appropriation. It also allows the Commission to spread its cash resources among several substantial purchases, rather than to postpone all but one due to a lack of funds. Furthermore, it allows the

price to be agreed upon and fixed at present values, just as though the entire parcel were being bought now, or as though the Commission had a long term option. The price of the last installment is the same as the price of the first installment.

Such an arrangement should appeal to the seller as well. He spreads his capital gains over a period of years. If the Town takes title at the beginning, he does not have to pay local property taxes, yet can continue to use the land in ways agreed upon at the time the bargain was settled until the last installment is paid. If the land is farm land, it can remain in productive use. The bargain should of course stipulate that the seller does not cut down trees or mine gravel or otherwise change the character of the property. It is arrangements like this, tailored to the needs, desires, or limitations of each party, that are most likely to be successful.

Life Tenancy

Life tenancy is another attractive offer to make sellers, whether the land is sold all at once or in installments. The Commission buys the property with the provision that the present owners can continue to use the land, subject to normal conservation restrictions, for a stated period of years or as long as they live. The tenancy can even be extended to include the life of the owner's children. This could obviously be a long time, nonetheless the Town will acquire the property in the end. In fact, the prospect of lifetime use of the land, free of all property taxes, may very well pursuade the owner to give the land or to accept considerably less then current value. At the least it can be used to pursuade a reluctant seller to part with his land after all. By offering additional advantages like this, the Conservation Commission may be able to accomplish far more with yearly allocations than it could if it bought the land without any accompanying arrangements.

Purchase and Lease Back

Another way to make the Town's conservation dollars go further is to recoup some of the money spent. Purchase-and-lease-back permits this. A town buys the land, then rents it to the previous owner or to some other tenant who will use it in a manner compatible with the Town's interests. In Middleborough this technique may be most applicable in cases where owners of key tracts are being forced to sell to developers because of burdensome taxes. They may prefer to sell to the Town at an equal or even reduced price if they can remain on the land. Their burdensome taxes are replaced by a somewhat less burdensome rent. The Town gets a tenant to maintain the land, a guarantee (as owner) that the land will be preserved, and some compensation as well, though not as much as it would from taxes. Purchase-and-lease-back may also be used to buy land long in advance of need, when it is available at a reasonable price, and yet not lose revenue from the land in the short run. The principal difficulty with purchase-and-lease-back is that the capital has to be expended all at once. At

the very least, the Town should investigate the possibility of gaining some revenue through renting idle tracts which it currently owns, such as land acquired through tax foreclosures.

Purchase and Sale Back

Another way to retrieve the cost of purchasing land is to resell the land later. Purchase-and-sale-back entails buying a tract and then re-selling it subject to restrictions that will forward the goals of the Conservation Commission. For example, the Commission might but land that occupies a key visual position at an important intersection, and then re-sell it subject to the provision that it will be used for agriculture or forestry or that the set-back for development will be greater than that which is specified in the zoning. The result would be the same as simply buying a restriction, but the net cost might be more favorable to the Commission. Purchase-and-sale-back might also be the only way to acquire the restriction short of using eminent domain, since many owners want to sell all or nothing and are unjustifiably wary of the effect restrictions might have on disposing of their property.

The Town may want to employ purchase-and-sale-back to accomplish more than just the placing of a restriction. The Town may want to become an active partner in promoting development of the kind that it likes and in the location that it prefers. For example, if a visually conspicuous parcel is likely to be developed for housing, the Town may wish to buy the land and then re-sell it to a developer who is highly regarded rather than let a less dependable

regarded rather than let a less dependable developer buy it. If the Town desires a certain kind of development, such as cluster development, or a small shopping center, it may want to buy the land and then sell it to a developer who specializes in the use the Town has in mind. If the Town is astute, it could reap a handsome return in the process. In short, the Commission should not only know how best to preserve land, but also how to guide its development where development is inevitable.

Assessing Betterments

Another way to regain some of the expense of purchasing conservation or park land is to assess a portion of the costs to those who directly benefit. To assess betterments in this manner is possible only where a limited number of people can be shown to benefit more than others. For example, if it can be shown that a local park or reservation increases property values of the nearby lots, then a substantial share of the costs of acquiring the land can be assessed to those benefitted.

Purchase of Strategic Parcels

Another way to stretch each conservation dollar is to buy parcels that in effect control the surrounding land or provide a defensible interest regarding the use or alteration of adjoining areas. For example, if an agricultural company plans to fill in a swamp, it cannot be enjoined under current wetlands legislation. Yet it might be prevented or at least greatly restricted in carrying out its plan if the Town actually owned land which may be adversely affected.

In this instance, it would be reasonable for the Town to bring suit, claiming that its property would be flooded or dried and its conservation value diminished because of neighboring action. As a consequence, the company might be required to assume greatly increased costs in terms of diking or other measures aimed to protect the few parcels that are not theirs, and so the operation might become unattractive.

The Town could also attack the company's title. Wetlands are notorious for having cloudy titles, particularly in the East where titles date back to colonial times, and are based on surveys referring to old roads, trees, and other landmarks that may be long gone. The heirs also may be gone, scattered over the country. In some cases it could be difficult for a challanged owner to prove that he owns a swamp, or just what part he owns. On the other hand, the title of the Town could be cleared through eminent domain proceedings, and thus be beyond question. In this way the right of the Town to defend its land from damage would be strong, while the right of the agricultural company to alter land that might not be theirs could be questionable. For this reason, the Town may want to acquire and clear title on parcels in major swamps and wild wastelands throughout the Town. Cases like this one point up the potential value to the Town of small and scattered parcels of tax delinquent land. The Conservation Commission should determine the location of these parcels and arrange to have control of some transferred to itself, after the Town gains ownership through foreclosure of auction. The Commission may even want to gain control by requesting an auction and bidding itself.

Conservation Fund

Finally, if the Conservation Commission had more money, it could obviously do more. Aside from asking for larger allocations, the Commission may also want to work for the establishment of a large Conservation Fund financed by a special bond issue. With a large sum now, the Commission could buy while prices are lower than they will be later. There can be no doubt that if the Town does not act to acquire land now, it will wish it had later when it is forced to go ahead under more costly conditions. The Commission and the Town may even want to consider the possibility of swapping future conservation allocations for a number of years in return for a large sum now in order to create a comprehensive open space system as soon as possible.

Easements

Easements offer other opportunities to stretch conservation dollars. This approach and the other matters mentioned in the remaining sections of this commentary are covered quite adequately in the Conservation Commission Handbook, and so the discussion here will touch only on a few points.

Easements provide a means to acquire a limited rather than entire interest in a piece of land. The limited interest should serve the purpose of the Commission, yet cost less than undivided ownership. The land will continue to be maintained by the owner and will continue to yeald property taxes, although the assessment may have to be lowered if the easement diminishes the

value of the land. Such readjustment would make selling or giving easements more attractive to owners, and so might be worth encouraging as a Town policy. At the least, the assessment should not be raised at some future date, if there is a binding agreement that use of the land is restricted. Even if taxes are not lowered, owners may like the idea of selling easements because of the lump sum they will gain, while yet being able to continue to use the land much as they have in the past. This arrangement can be particularly attractive if the alternative is forced sale of entire ownership through eminent domain. Of course, eminent domain can also be used to acquire an easement. If the Town Commission is reluctant to take land, they may want to adopt a somewhat softer approach by taking limited easements which could serve its purpose as well, yet not encounter the same degree of opposition from owners. However, condemning easements can sometimes be almost as expensive as acquiring outright ownership when what is taken has an unclear effect on resale values. For this reason, 'second chance' eminent domain should always be employed.

Easements can be of two types, positive and negative. The latter might be called restriction. Positive easements entail the right to do something with part of a persons property. For example, the Town might acquire the right to flood someone's land with water backed up from a dam, or to cut shrubs in order to maintain a view from the road. The Commission might acquire the right-of-way for a footpath or a bicycle trail running along a stream or

connecting two Town properties. Such pathways should be placed where they will disturb the landowner least, preferably along his property line.

Negative easements (i.e. restrictions) do not entail public access or use of the property. Rather, the Commission acquires a guarantee that the owner will not use the land in certain ways: he will not cut the trees, he will not mine gravel, he will not subdivide, he will not erect billboards. Yet, except for the restrictions, he continues to use the land just as he had before. An owner might gain more from such a restriction than he gives up. By agreeing not to develop a particularly scenic streamside, for example, he may enhance the value of other portions of his property which will be reflected in later real estate market evaluations.

Easements, both positive and negative, can be particularly inexpensive and effective when used in combination with zoning. For example, if a wooded swamp is already zoned as a wetland and hence has little potential for development, the owner may be only too glad to reap a little added income in return for selling an easement permitting public access across his land on a swampland trail that might bridge the wettest parts with a boardwalk. Such an easement would mean almost nothing to an owner as far as effecting his use of the land, and he might gladly give it in return for slightly reduced taxes or as a charitable contribution that can be deducted from his income tax.

Similarly, the Conservation Commission might want to purchase a conservation restriction prohibiting the filling of a wetland. Filling wetlands is already regulated, but a restriction would prevent filling for some agricultural purpose (probably excluding cranberry bogs) and would also obviate the need to delineate scientifically just which lands are dry and which are wet enough to be restricted by the law. The restriction could prevent altering land within certain specified bounds, whether wet or dry. Such an approach may cost the Town less than the expense of delineating its wetlands in order to enforce wetland zoning effectively. Since the law already severly restricts the use of wetlands, additional protection should be purchasable at a very low price, or again as something which the owner is willing to give away. Any income or tax benefit that he can get from his marginal wasteland is a windfall to him.

The ideal land for acquiring easements at a low cost is land which is largely worthless from a commercial point of view, or conversely, land which can continue to earn money in an open condition subject to restrictions. This latter group includes principally farms and orchards. If a farm is in financial trouble, or even if it is not, the owner may welcome the opportunity to sell or give development restrictions on his land in return for a yearly write-off on his income tax or a readjustment in property tax.

If an easement is acquired through purchase rather than gift, the Commission may want to arrange for deferred payment. Under this arrangement, payment is postponed until the land subject to the restriction is sold. If the sale price is lower than the appraised value of the land before the restriction (adjusted for inflation), the Commission makes up the difference. If the restrictions have been applied only to categories of land described above, to undevelopable wetland or to profitable farmland, and in other cases have been applied selectively to protect scenic qualities, the sale price should not be diminished below the earlier evaluation. This would be particularly true in Middleborough, where open space has a very low evaluation to begin with.

The best way to keep down the cost of an easement is to make sure that it is clearly framed, so that the owner knows the limits of what he is giving up, and is not afraid that his control of the land is being undermined. An easement which explicitly enumerates what privileges the public gains or the landowner loses will lend itself more readily to an estimation of the before-and-after valuation of property. It will also make landowners entering the bargain feel more comfortable, and will avoid violations from misunderstanding and ambiguity.

Taxation and Conservation

The relationship between taxes and conservation is outlined in The Massachusetts Conservation Commission Handbook. As mentioned before, in all fairness to land owners, and also as a way to encourage gifts or sales of easements and

conservation restrictions to the Town, Middleborough should adopt a policy of recognizing the diminished value of real estate to binding restrictions.

The Conservation Commission obviously does not have the power to alter the taxes of the Town or of any individual. Nonetheless, one or more Commission members should have a working knowledge of current tax laws in order to be able to explain to prospective donors of land or of an easement the tax advantages that will accrue from their gift.

When computing federal income tax, a donor may deduct the value of a gift against up to thirty percent of his income. So as to get the total value for his gift, he may spread it over a number of years. At the same time, he avoids paying a capital gains tax and of course, no longer pays real estate taxes. By giving land at his death, his family avoids paying an estate tax. Or he may give land subject to life tenancy, and so deduct the value of most of the land against his income during his lifetime. In short, any negotiation for the acquisition of land should highlight the tax factors that may save money for both the owner and the Conservation Commission.

The Conservation Commission may want to encourage owners of idle land to devote it to forestry. Such use would serve conservation purposes while also enabling the owners to qualify for a tax abatement that might help them to resist selling their property for development. Tax abatement is granted on lands that the Department of Natural Resources has certified to be under an approved form of forest management. Such a tract is taxed at one to three percent of its income from timber. The law applies only to parcels of ten acres or more worth not more than four hundred dollars per acre. While the Town benefits as long as the land remains in forestry, it does lose tax revenue as land appreciates.

Outside Funding

One of the most attractive methods for a community to increase the effectiveness of each conservation dollar is to receive matching funds from State or Federal sources. The requirements and procedures for receiving State Self Help funds are outlined in the Conservation Commission Handbook.

The State will not pay more than the municipality itself, but may bear up to fifty percent of the costs. Of course, it prefers to pay less by supplementing local and State money with Federal funds. A common division is 25% municipal funds, 25% State funds and 50% Federal funds.

The State has various criteria which it weighs when considering applications for funds. One requirement is that the Town have a comprehensive master plan, and more specifically, a Natural Resource Inventory and an Open Space and Recreation Plan. This report is intended to serve as such an inventory and plan.

An application for State funds should explain that Middleborough's inordinately large size

obscures the fact that most of the Town, and in particular the part with most of the people, is far from any major open space reservations. Even the State wildlife reserve and the Merle Washburn Conservation Area consist mostly of soggy woods and swamp that do not lend themselves to active human use. The preservation of land bordering ponds and rivers should be emphasized, due to the attractiveness of such areas to people as well as for their importance to wildlife and waterfowl. The major rivers and ponds are concentrated near areas that will probably receive most of the Town's development.

Multi-use Areas and Inter-departmental Cooperation

To derive maximum benefit from funds, the Town should concentrate on projects that are likely to serve many ends at once, such as historic preservation, passive recreation (like fishing and walking), wildlife protection and water supply conservation. In an application for State assistance the multiple advantages and the partnership among Town departments should be stressed. The same is true of possible cooperation between Middleborough and surrounding towns. Inter-minucipal cooperation is a sufficiently rare phenomenon that it deserves attention and assistance when it occurs.

Regional Contribution

When applying to the State or any other agency with a regional preview, Middleborough should concentrate on projects that will produce regional benefits, or tie in with work being promoted on a regional scale. The bicentennial anniversary and resultant tourism offer a convenient theme for regional effort. The Commission might like to focus on projects which relate in some way to the bicentennial celebration and to historic points of interest in Middleborough and neighboring towns. For example, the bicentennial might lend particular timeliness, and the theme of regionality might lend additional support, to a proposal for a scenic Plymouth highway or to acquiring rights-of-way for regional walking or bicycle trails.

As a final point, any funding agency is interested in proposals illustrating ways in which its money can be used more effectively. Most State and Federal money is used for the simple (and grossly expensive) purchase of land. One form of economy would be to employ some of the money-stretching techniques described earlier: life tenancy, purchase-and-lease-back and easements. These are time-honored techniques, but their use by municipal conservation commissions is relatively new.

Applications for Federal HUD grants are also evaluated on the basis of certain criteria. Emphasis is placed on urban open spaces that will serve low moderate income neighborhoods. An application for a HUD grant should emphasize that although Middleborough has extensive countryside, there is substantial need for more open space near or within the urbanized area of this middle-income town. If funds are going to be sought specifically for playgrounds, tennis courts and other recreational sites, the Bureau of Outdoor Recreation should be considered.

Zoning and Subdivision Control

Wetland Zoning

Through the power to zone for or against certain activities, a community can shape its land use without expending municipal funds or acquiring an interest in property. The type of zoning of greatest interest to the Conservation Commission in Middleborough is probably wetland zoning. Although the Commission already has the power to review proposals to fill wetlands (powers granted by the Wetlands Protection Act of 1972) the effectiveness of the law is diminished by the fact that the owners may be unaware of their obligations to seek permits to alter swampy areas. Furthermore, many owners may contend that their land is not sufficiently wet to be restricted under the law. The Inland Wetland Act, by comparison, calls for the designation of a wetland zone by the State and requires that all owners of land within the zone be informed of the restrictions that apply. Neither act applies to filling wetlands for agricultural purposes.

To inform landowners of their obligations under the currently applicable Wetlands Protection Act, the Conservation Commission may want to send notices by certified mail to all deed holders of any land in Middleborough informing them of their responsibility to seek permission to fill or dredge any wetland that may be on their property. The Commission should also inform landowners of their obligations through statements in the Town Report, articles in the newspaper, and public displays and meetings.

Such statements would serve as well to alert Townspeople to the fact that any filling or diking operations should be brought to the attention of the Commission. The Commission should also seek the cooperation of the police, who have powers of inspection and enforcement.

The Town may want to go further by establishing a wetlands zone for conservation purposes. Until the State tightens its restrictions Middleborough has a wetlands district in which certain restrictions are imposed on residential development. The restriction within this district could be enlarged to prohibit dredging and filling without a permit from the Conservation Commission. Agricultural operations need not be exempted. The zone should be delineated on a map. This is a technical procedure, but some towns in Massachusetts have done it themselves. Lincoln, for example, has delineated a zone with the aid of a geologist and other volunteers who made site inspections.

Floodplain Zoning

Middleborough may want to consider the adoption of a floodplain zone superimposed like a wetlands district. Floodplain zoning is intended to prevent the development of structures in areas which, because of annual or periodic flooding, would endanger the occupants and the community. Although the rivers in or bordering Middleborough are in most places well-confined in their channels, such a law would help to prevent the development of stream banks, which because of their beauty and recreational possibilities are magnets for residential speculators. Such areas may more

compatibly be devoted to agriculture, forestry, recreation, or other uses by special permit. The zone can be bounded by a line representing the fifty or one hundred year flood mark. This boundary can be established by reference to actual flood lines from recent hurricanes, by employment of a minimum set-back, by using a series of contour lines that step down as the river flows downhill, or by a combination of all three.

Cluster Zoning

Cluster zoning is another means whereby the Town can shape development. This variety of zoning permits a developer to reduce the size of individual house lots so as to cluster his dwellings around one or more nodes rather than spread them evenly along a network of streets as is customary in a conventional subdivision. The total number of dwellings should be the same in either case; a cluster subdivision simply concentrates them in certain areas, thus permitting the developer to save on roadways, utility lines and construction costs. The result is more efficient use of land, a better designed development, and the preservation of the land that is not built on as permanent open space, at no cost to the community. See Cluster Zoning in Massachusetts by Katharine Kulmola and Cluster Development by Willaim H. White for a comprehensive discussion of cluster zoning.

Cluster zoning is a goal worthy of the Commission's support, however, certain factors should be considered. First, the zoning should be voluntary. The developer should have the alternative of building under conventional zoning. The voluntary nature of cluster zoning makes it possible for the Town to require various concessions from the developer that would not otherwise be legal. For example, the Town can require that the open space be deeded to the Town, if it wishes it. The Conservation Commission should be given control over such land if the Town wishes to accept it. Alternatively, the Town can require that the public have access to the open space, even though the land will continue to be owned by the development through a mandatory home-owners association which must maintain the land and pay its taxes. In either case, the open space should be covered by conservation restrictions requiring that the area remain undeveloped in perpetuity.

Cluster development should be subject to a design review by the various departments of the Town. This review can be more exacting than is permitted for a conventional subdivision, which remains as an alternative. For example, the Conservation Commission should check to see if there are ways for the open space to tie in with other open areas or trails already established beyond the limits of the property or which may someday be developed in neighboring subdivisions. As mentioned before the developer of a cluster project should not be permitted to build more units than he would have under conventional subdivision. The area should first be plotted in conventional lots and tested for septic drainage to see what the developable potential of the site is.

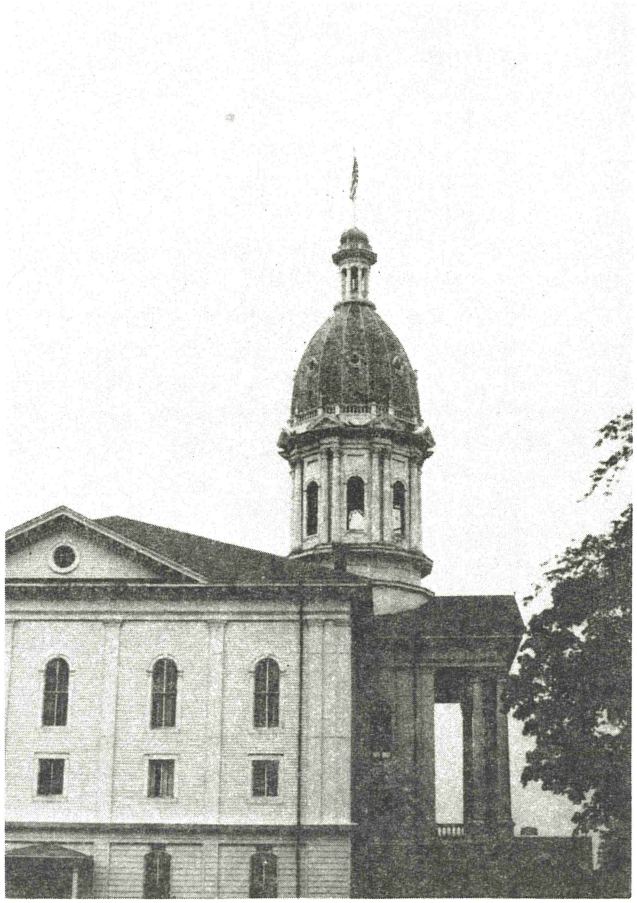
Historic District Zoning

Another variety of zoning practicable for Middleborough and entirely worthy of the support of the Conservation Commission is historic district zoning. By means of this legislation, areas that are significant to national, state or local history can be designated and preserved. No exterior alterations may be made within these zones. In formulating its plans, the Commission should consider where these historic zones are likely to be established, and if possible, try to work them into open space corridors and trail systems.

Subdivisions

In view of the lack of neighborhood parks and playgrounds in Middleborough, the Planning Board should exercise its right to require that subdivision plans show a park or parks suitably located for playground or recreation purposes. The Board should prohibit building on such parcels for three years in order to give the Town time to consider their purchase.

If a developer is granted permission to proceed contingent upon a promise to correct deficiencies in surface drainage or to provide a sewer extension beyond what the Town has reasonably budgeted, he should be required to post a bond as a guarantee that the work will be completed so that the site is not left derelict. The same bonding procedure should be applied to gravel mining to ensure that the land is restored to natural contours after the operation is completed.



SUMMARY

The previous discussion has outlined some of the procedures that the Middleborough Conservation Commission can employ to promote environmental awareness and to purchase or otherwise preserve open space for conservation and recreation. Obviously, there is no single best method of control or finance. Different strategies work better with different landowners and different parcels of land. A combination of methods for separate areas or even for the same area is usually the most effective approach. For example, life tenancy can make the sale or gift of land more palatable. Easements across private land can supplement trails on municipal property. And conservation restrictions or local wetland zoning can plug the loopholes in the State wetland legislation.

Just as a combination of approaches yields the strongest protection, so a range of values indicates the best land to preserve. Areas which serve several purposes at once deserve top priority for acquisition and protection. For example, an area which is valuable for recreation, wildlife, and water conservation deserves preservation more than some other area which provides only one of these benefits. In short, a variety of implementation techniques and a multiplicity of public benefits are the main themes of an efficient program to conserve Middleborough's recreational, historic and natural resources.

7
CONCLUSION

CONCLUSION

Middleborough now has a wide base of environmental information which will be a useful guide to future acquisition of conservation and recreation lands. Information which has already been compiled can easily be updated and changed as more base information has become available and as local conditions and priorities change. The maps and information will be available to developers who are interested in learning of any environmental conflicts and associated construction costs brought about by their proposed plans. Local residents and interest groups will also have access to the information so that they might learn more about their environment and their role in it.

This study can provide some needed guidelines for shaping development. The next step in the planning process is to arrive at more detailed and specific site information. This can be done by enlarging the existing base maps and superimposing actual assessors' property lines. This need not be done for the entire Town, but only for high priority areas where natural resource protection is most essential. These areas are indicated by the Composite Natural Resources Map. At this scale, more in depth field investigations will be necessary. In addition, the exact location of larger parcels of tax delinquent or 'Town owned' lands will be significant for acquisition purposes. These lands, where they coincide with open space priorities, should be mapped (on a transparent overlay perhaps) and evaluated. They are listed in the Appendix to this Report.

The resource maps can be helpful in determining the relative value of two different parcels of land for conservation or recreation purposes, which may not coincide with already-defined critical resource areas, but which may become available to the Conservation Commission or to the Town. If one such parcel combines more resource potentials than the other, the Town would get 'more for its money' if it bought such a parcel. A general comparison of the sites on each inventory map would be a guide to their relative potential.

Basic educational information can be drawn from this study, for use by the Conservation Commission or other Town departments. More in depth research can be done from the bibliographic source material. Essential to the vitality of this report is communication and local cooperation. Section 6, Implementation Strategies, suggests how these objectives might be accomplished.

The Open Space Plan is not the end product; it depends entirely upon the support of the Townspeople, its landowners and decision-makers, for its implementation. It is not to be expected that the plan will take shape immediately; but it does provide a framework within which a phased open space system can be logically developed. It should be used in conjunction with the existing Town Master Plan and to gain financial support at local, State and Federal levels as a consistent and systematic approach to Town land use planning.

Most importantly, there must be an underlying assumption locally, that development can be accomplished in patterns which work with natural forces--to the enhancement of both. Policies for development should be adjusted to the 'carrying capacity' of the land. The first step toward that goal is to increase the body of knowledge about natural systems, and to identify locational patterns of relative environmental value. Hopefully, with Priorities for Open Space, this has been accomplished in Middleborough.

Tispaquin Pond

8
BIBLIOGRAPHY & APPENDIX

BIBLIOGRAPHY

Abbey, Dennis Gail, et. al. Cluster Zoning: A Citizens' Handbook for Better Land Use. Harvard Graduate School of Design, Dept. of Landscape Architecture, 1973.

Association of Bay Area Governments. How to Implement Open Space Plans. San Francisco, 1973.

Baker, John A. Wetland and Water Supply. U.S. Geologic Survey Circular No. 431. Washington, D.C., 1960

Baldwin, Helene and C.L. McGuiness. A Primer on Groundwater. U.S. Government Printing Office, 1963.

Case, H.W., et. al. Bikeway Planning Criteria and Guidelines. Institute of Transportation and Traffic Engineering, School of Engineering and Applied Science, UCLA, 1972.

Chamberlain, Barbara Blau. These Fragile Outposts. The Natural History Press, Garden City, New York, 1964.

Comitta, Thomas J., and Bruce Q. Rado (editors). Land Resource Analysis: Barnstable, Mass., Harvard University, Department of Landscape Architecture, 1972.

Comitta, Thomas J., Bruce Q. Rado and Peter Goodale. A Plan for Open Space: Barnstable, Massachusetts. Harvard University, Dept. of Landscape Architecture, 1973.

Davis, Jeanne M. and Peter House. Open Space: Its Use and Preservation. Economic Research Service, U.S.D.A. Miscellaneous Publication No. 1121, USGPO, November, 1968.

Dawson, Alexandra and Robert J. Ellis. Massachusetts Conservation Commission Handbook. Massachusetts Association of Conservation Commissions, Boston, 1973.

Ells, Stephen F. Open Space and Recreation: Open Space Law. Metropolitan Planning Council, Boston, 1969.

Golet, Francis C. Classification and Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast. Massachusetts Cooperative Wildlife Research Unit. June, 1973

Goodwin, Richard H. and William A. Niering. Inland Wetlands of the United States Evaluated as Potential Registered Natural Landmarks. Connecticut College, New London, May, 1971.

Grbenick, Thomas, et. al. Growth, Change, Environment: Londonderry, New Hampshire. Harvard Graduate School of Design, Dept. of Landscape Architecture, June, 1972.

Gupta, Tirath R. Economic Criteria for Decisions on Preservation and Use of Inland Wetlands in Massachusetts. Department of Agriculture and Food Economics, University of Massachusetts, 1973.

Hartshorn, Joseph H. Geology of the Bridgewater Quadrangle, Massachusetts. U.S. Geologic Survey Map No. GQ-127, Washington, D.C., 1960.

Johnson, Johnson and Roy, Inc. Boardman River Study. Ann Arbor, Michigan, September, 1973.

Koteff, Carl. Geology of the Assawompset Pond Quadrangle, Massachusetts. U.S. Geologic Survey Map No. GQ-265, Washington, D.C., 1964.

Leopold, Luna B. and Walter Langbein. A Primer on Water. U.S. Department of the Interior, Washington, D.C., 1960.

Lustgarten, David and Jane Young. Conservation Planning: An Analysis. Harvard Graduate School of Design, Department of Landscape Architecture, 1973.

MacConnell, William P. Massachusetts Map Down 1971 Land Use and Vegetative Cover Mapping. University of Massachusetts, Department of Forestry and Wildlife Management, Amherst, April, 1972.

Metropolitan Area Planning Council. Open Space and Recreation Program for Metropolitan Boston, Volume 4, Massachusetts Open Space Law. Boston, Massachusetts, 1969.

Massachusett Department of Commerce and Development. City and Town Monographs: Town of Middleborough. Boston, June, 1972.

Mayewski, Leo L. Master Plan: Town of Middleborough, Massachusetts, 1969-1971. Metcalf and Eddy, Inc. Boston, Massachusetts, April, 1971.

McHarg, Ian L. Design With Nature. Falcon Press, Philadelphia, 1969.

Natural Resources Technical Team of Plymouth County, Middleborough Town Advisory Group. Inventory of Sites with Natural Resource Development Potential: Phase I Study. February, 1970.

New England Division, Army Corps of Engineers. Preliminary Single-Purpose Plan Report: Inland Wetlands Management, Taunton River Basin. New England River Basins Commission, September, 1973.

Reilly, William K., ed. The Use of Land: A Citizens' Policy Guide to Urban Growth. Thomas Y. Crowell Company, New York, 1973.

Rodiek, Jon. A Natural Resources Atlas for Plymouth County. Cooperative Extension Service, Amherst, Massachusetts, February, 1973.

Sax, Joseph L. Defending the Environment. Alfred A. Knoph, New York, 1971.

Smith, Robert L. Ecology and Field Biology. Harper and Row, New York, 1966.

Soil Conservation Service. Aerial-Photo Interpretation in Classifying and Mapping Soils. Agricultural Handbook No. 294, USGPO, Washington, D.C., October, 1966.

Strahler, A.N. The Environmental Impact of Groundwater Use on Cape Cod. Association for the Preservation of Cape Cod, Inc. Orleans, Massachusetts, 1972.

Swenson, H.A. and H.L. Baldwin. A Primer on Water Quality. U.S. Government Printing Office, Washington, D.C., 1965.

Thompson, Elroy S. History of Plymouth, Norfolk and Barnstable Counties, Massachusetts. Lewis Historical Publishing Company, Inc. New York.

Trustees of Reservations. Annual Reports. Milton, Massachusetts, 1971 and 1972.

Upham, Charles W., et. al. Soil Survey, Plymouth County, Massachusetts. U.S. Dept. of Agriculture, Soil Conservation Service, Massachusetts Agriculture Experiment Station, 1969.

U.S. Department of the Interior. Historic Buildings Survey. W.P.A. Project, 1943.

Wallace, David A., ed. Metropolitan Open Space and Natural Process. University of Pennsylvania Press, Philadelphia, 1968.

Way, Douglas S. Terrain Analysis. Dowden, Hutchinson and Ross, Inc., Stroudsburg, Pennsylvania, 1973.

Whyte, William H. The Last Landscape. Doubleday and Company, New York, 1968.

Williams, Edward A. Open Space: The Choices Before California. The Urban Metropolitan Space Study.

Williams, Jr., D.F. Farrell and R.E. Willey. Water Resources of the Taunton River Basin, Southeastern Massachusetts. U.S.G.S. Hydrologic Investigations Atlas HA-460, Washington, D.C., 1973.

The following is a list of birds and mammals known to live in or travel through the town of Middleborough, particularly in the vicinity of the Great Cedar Swamp. Much of the Great Cedar Swamp has been destroyed by filling and clear cutting.

Raccoon
Deer
Muskrat
Red Squirrel
Gray Squirrel
Eastern Cottontail
Red Fox
Gray Fox
Opossum
Mink
Otter
Skunk
Weasel
Woodchuck
Rat
Great Blue Heron
Black Duck
Goshawk
Redtail Hawk
Red-shouldered Hawk
Broadwinged Hawk
Rough-legged Hawk
Robin
Yellow-shafted Flicker
Downy Woodpecker
Great-crested Flycatcher
Phoebe
Wood Pewee
Blue Jay
Common Crow
Black-capped Chickadee
White-breasted Nuthatch
Brown Creeper
Catbird
Brown Thrasher
Wood Thrush
Northern Shrike
Yellow-throated Vireo
Black and White Warbler
Yellow Warbler
Black-throated Green Warbler
Yellowthroat
Starling
Redwinged Blackbird
Baltimore Oriole
Common Grackle
Scarlet Tananger
Rufous-sided Towhee
Swamp Sparrow
Song Sparrow
Fox Sparrow

Source: Mrs. Dorothy Briggs, Middleborough resident and cooperator for the Department of the Interior, Division of Fisheries and Wildlife.

Trails:

1. Wagon Trail to Iron Mill Site
2. Indian Trail along the Nemasket River
3. Oliver's Walk; from the Oliver Estate to the town center; potential linkage
4. Abandoned Stage Coach Route; potential open space linkage to South Middleborough area

Historic Structures:

1. Fort Hill
2. Second Red School House*
3. Stone Fireplaces (3) from Colonial cabins
4. Mill foundation
5. Oldest one-room schoolhouse*
6. Eddy House*
7. Small Pox Cemetary and hospital
8. Tom Thumb House
9. Furnace for Oliver Mill (bog iron)
10. Oliver House and estate
11. Oliver Mill*
12. Judge Oliver House
13. Green School; one-room schoolhouse
14. Sawmill
15. Colonial Fort
16. Revolutionary Period foundry
17. Reed Cemetary
18. Ice House
19. Hell's Blazes Tavern; iron smelting

UNIQUE RESOURCES (continued)

Historic Places:

20. North Middleborough;* Pratt Free School, Pratt House, Gurney House, Congregational Church, Isaac Backus House, Red School House
21. Lion's Neck; oxbow in the Nemasket River
22. Moulton Hill
23. Danson Brook; scene of early battle in King Phillip's War
24. Eddyville*
25. Seven Ponds; early brick yard and factory
26. Thousand Pines
27. Indian Campground; boulder crossing of the Nemasket
28. Oliver Mill area
29. Middleborough Ice Pond
30. The Green
31. Nevertouch Pond
32. Pierce Store; Railroad Station; Central Methodist Church; Library; Robinson Law Office; early town center*
33. The Wading Place
34. Barden Hills Indian Campground
35. Tispaquin Pond Indian Camp; Indian Island
36. Assawompset Dig; Indian settlement
37. Twelve Man Purchase
38. Indian cave

Unique Natural Features:

39. Great Cedar and Little Cedar Swamps; Atlantic White Cedar and White Pine stands
40. Geologic formation: eskers
41. Bedrock outcrop: Dedham granodiorite
42. Bedrock outcrop: Rhode Island shale
43. Geologic formation: esker
44. Geologic formation: knob and kettle topography

UNIQUE RESOURCES

Unique Natural Features (continued):

45. Bedrock outcrop: Dedham granodiorite with glacial striations oriented south-southeast
46. Barden Hill ; geologic formation: kame
47. Indian Island; Hemlock, American Holly and White Cedar
48. Devil's Kitchen Swamp; Swamp Laurel, Azalea and American Holly

Unique Visual Features:

49. Lion's Neck: Deciduous woodland/river edge; oxbow formation
50. Cranberry bogs
51. Nemasket Hill Cemetary; overlook to Nemasket River, footbridge access
52. Plymouth Street: Old Field/Agricultural area; visually sensitive; Scenic Highway designation potential
53. Main Street, Middleborough; Grove Street (Route 28) to Nickerson Street
54. Barden Hill: lookout tower with panoramic regional view; visually sensitive
55. Stone Bridge: potential shared recreational access with Lakeville
56. Tispaquin Pond: Woodland/water edge
57. Rocky Gutter Road: Densely forested area
58. Cranberry bogs
59. View to Assawompset Pond: Woodland/water edge
60. The Highlands: visually sensitive area
61. Marion Road: Historic homes and farmsteads; Scenic Highway designation potential

*Also of interest to the Middleborough Historical Commission

APPENDIX C

EXISTING RECREATION AND CONSERVATION FACILITIES

Facility Name	Type	Acre Size	Features
1. Thomas Sproat Pierce Playground	Playfield	24	Four lighted tennis courts and two ball fields; four shuffle-board courts; combined basket-ball court and skating rink; child's play area; 150 x 75 foot swimming pool; field house
2. West Side Playground	Playground	10	Child's play section; ball field; picnic facility
3. VFW Ball Field	Playfield		Ball field
4. Oliver Mill Park Restoration	Community & Neighborhood Park	6.5	Picnic facilities; passive recreational use planned
5. Nemasket Run	Community & Neighborhood Park	2.0	Fishing and limited picnic sites proposed
6. Town Forest	Community Park	94	Proposed hiking and bike trails; camping and picnicking sites

EXISTING RECREATION AND CONSERVATION FACILITIES (continued)

Facility Name	Type	Acre Size	Features
7. Fred C. Weston Memorial Park	Community Park	258	Proposed for hiking and bike trails, camping and picnicking sites
8. Mayflower School	Playground		Swings
9. Burkland Jr. High School	Playfield		Open field
10. Fall Brook Conservation Area	Conservation and Open Space	190	Wooded wetlands
11. Rocky Gutter: Massachusetts Department of Natural Resources	Wildlife Refuge	1700	Wooded wetlands

TOWN OWNED LANDS WITH POTENTIAL FOR OPEN SPACE ACQUISITION

APPENDIX D

Assessor's Map Number	Area in Acres	Location
R8-1A	14.69	Off Plymouth Street
R22-3	14.0	Brook Street
R27-1	14.0	Plympton Street
R35-11	25.0	Chestnut Street
R35-12	22.5	Chestnut Street
R36-3	10.0	Tispaquin Street
R38-2	20.0	Off West Grove Street
R41-2	10.0	Chestnut Street
R43-31	14.0	Carver Street
R45-13A	16.0	Wood Street
R46-7A	47.7	Off East Grove Street
R47-8	56.1	Between Tispaquin and Purchase Streets
R51-1A	27.9	Fall Brook
R51-6	22.7	Cherry Street
R53-14	202.0	Between Tispaquin and Purchase Streets
R53-67	22.3	Off Cherry Street
R58-5	14.0	Walnut Street
R58-77	10.0	Miller Street
R59-33	145.0	Miller Street
R64-40	46.0	Wareham Street

TOWN OWNED LANDS (continued)

Assessor's Map Number	Area in Acres	Location
R64-52	12.5	Wareham Street
R77-18	10.0	Off Wareham Street
R78-16	13.1	Old Wareham Street
R79-4	23.12	South of Route 25
U10-11	10.0	Plymouth Street
U21-12	10.0	Plymouth Street
U49-16	29.0	East Main Street
U55-78	10.0	West End Avenue
U57-197	24.25	North Main Street
U73-6A	29.54	East Grove Street
U73-7	30.0	Wood Street
U80-1A	13.3	Off Cherry Street

NOTE: This listing includes all town owned parcels of 10 or more acres, some of which may be in use for school facilities or other town purposes; many smaller urban parcels are on the original Assessor's list, and these should be investigated as potential pocket parks and children's play areas.

MIDDLEBOROUGH, MASSACHUSETTS
Town Conservation/Recreation Plan
Preference Survey
November, 1973

APPENDIX E

1. Activities

a. Approximately how many times during the past year did you?

___ play softball, baseball, soccer, basketball or other team sport

___ play tennis

___ play golf

___ go bowling

___ go birdwatching

___ swim in a pool

___ swim in a river or pond

___ picnic

___ ice skate

___ go snowmobiling

___ fish

___ cross country ski or snowshoe

___ use a playfield or playground

___ go horseback riding

___ go bicycling

___ hike in the woods

___ go hunting

___ visit places of historic interest

___ visit a nature study area

___ take a dirve for pleasure

b. Check each activity above which you would like to do more often.

2. Places

a. Which of the following places have you visited during the last year?

(continued)

___ Oliver Mill Park ___ Tispaquin Pond ___ Jr. High Recreation Facility

___ Town Forest ___ Rocky Gutter State Park ___ Frederick Weston Memorial Park

3. Travel Routes

   a. Which of the following roads and streets do you use most often as you drive or travel through Middleborough?

___ Route 25 ___ Route 44 ___ Plymouth Street

___ Route 28 ___ Route 105 ___ Other: _____

4. Which of the following do you feel are problems for the town of Middleborough?

___ rapid, uncontrolled development of open lands ___ strip mining of sand and gravel

___ filling of wetlands ___ lack of adequate recreation facilities

___ soil erosion ___ pollution of groundwater

___ increasing tax rate ___ pollution of streams and surface water

___ sprawling roadside development ___ destruction of wildlife habitat

___ destruction of the rural quality of the town ___ decrease of agricultural lands

Rank the above 'problems' from 1 (most critical) to 12 (least critical).

5. What do you feel is Middleborough's most unique natural resource? Is there a particular area or feature that you would like to see preserved?

6. Would you like to participate in one of several meetings which will be held in order to establish priorities for the Open Space Plan for the Town of Middleborough based on this questionnaire response?

YES ___ NO ___ Name _____ Phone number _____

(continued)

If yes: Cross out date(s) you would not be able to attend:

Wednesday, March 20, 7:30 P.M.
Wednesday, March 27, 7:30 P.M.
Wednesday, April 3, 7:30 P.M.

Would you attend a Sunday meeting? _____

7. Do you feel you represent a particular section of Middleborough?

North ___

East ___

South ___

Central ___

8. Do you feel that you represent a particular interest group in Middleborough? (Sportsman, youth, new-comer, senior citizen, merchant, conservationist, agriculturalist, etc.)

Which interest group? _____